THE

ENGINEERING MAGAZINE

11225B

AN INTERNATIONAL REVIEW

VOLUME XX

October, 1900, to March, 1901

NEW YORK

THE ENGINEERING MAGAZINE

1901

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THE ENGINEERING MAGAZINE

VOL. XX. OCTOBER, 1900. NO. 1.

THE WORLD'S NEED OF COAL AND THE UNITED STATES' SUPPLIES.

By F. E. Saward. With Editorial Preface.

IT is about thirty-five years since Professor Jevons predicted that, by the end of the century, England's commercial and industrial supremacy would be checked by inability to supply the ever-growing demand for fuel. The coal which gave her economic dominion—which, more than iron, was the basis of her material power—was even then evidently exhaustible. With its disappearance, apparently, her wealth and power would decline.

Trade expansion, spreading further and faster than seemed possible to the most sanguine a third of a century ago, has hastened the condition upon which Professor Jevons based his sinister prophecy. But in the meantime other factors—material, economic, and political—have entirely changed the problem. New countries have opened up not only new markets for consumption, but new sources of supply; improved transport, particularly by sea, has brought far-off shores practically nearer than the distant portions of our own land; above all, a broadened understanding of national and international relations has drawn the whole world closer and is ever enforcing the concept that the great storehouse of the world is a common one—that the funds of material, of energy, even of human skill and handicraft, are in reality and inevitably a joint possession, which it is the duty and destiny of mankind to utilise and to distribute to the uttermost for the good of

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all. The new world, which supplied to the overburdened old world first room and opportunity to labour, then bread and clothing, now opens to the underfed furnaces, mills, and workshops of Europe almost limitless stores of the coal and iron which are the prime material necessities of modern life. These will prove as life-giving and as little to be considered menaces to England's prosperity as were the wheat of the prairies or the cotton of the southern States.

For England, who ever has been keen in discerning true commercial wisdom, prompt in acting upon it, and steadfast in holding to it, will seize upon the advantages of this development as she has upon events in the past, looking beyond the temporary and the superficial to the lasting and substantial interests of the manufactures and the commerce which have made her great. Anything that promotes those manufactures by cheapening them she will welcome and turn to advantage, shutting herself out from no benefits by self-made barriers of "protection" which cut off the inflow of wealth-making materials and the outflow of wealth-bringing products. With her far-seeing, strongly-founded system of free trade, she gathers to her open doors the best that the world can bring, sure of the soundness of a prosperity which is based, not on any artificial and shifting foundation of tariff legislation, but on buying where goods are best and cheapest, and so having the cheapest and best to sell wherever goods can be sold.

This is the true aspect of the movement toward "bringing coals to Newcastle," or to Cardiff. It is not an inroad on the British coal producer; ample home markets are his beyond possibility of loss. A portion of the burden of export demand, which is so seriously hampering the vitally-important home industries, may be assumed by the United States, with most beneficial results to England at large. Undue prices, checking prosperity and ultimately reacting to the disadvantage of the coal trade itself, will find their level. But if American coals can be landed in European ports at reasonable prices, it means simply that the thousands of factories, forges, workshops, and ship-yards, which are the framework of Britain's power, are assured against stoppage or decline. If America can feed Europe with coal and iron as she has fed her with wheat, the continents are entering on an era of surer prosperity, of greater mutual gain, of closer unity than any heretofore existing. Isolation within national boundaries belongs to a school of political economy which, happily, is dying. The country which gives the freest entry to the desirable products—material or intellectual—of other lands, to supplement its own store and liberate its own effort, is first in the progress toward wisdom, riches and power.—THE EDITORS.

COAL is heavy, both specifically and in its aggregate annual tonnage. It is by long odds the greatest item of the freight traffic on American railroads, constituting one-fourth of the total tonnage, and if we omit the duplication of tonnage resulting from the transportation of one shipment over two or more lines of railway it will be found that coal constitutes one-third of all the traffic moved in the United States. And although all indications now point to the fact that American progress towards the achievement of a great international coal trade will be steady and continuous, yet at the same time those who are concerned in the industrial progress of the United States need not fear that the exportation of coal will result in a diminished supply at home and increased prices for the fuel needed by manufacturers. Taking up the coal fields of the United States, as a whole, that is to say, the bituminous coal fields, with which alone exporters are concerned, it will be found that from the Atlantic to the Mississippi the country is well supplied, and though the quality gradually deteriorates as one progresses from east to west it so happens that each section is, or can be, supplied with suitable coal from its home fields.

In spite of continued effort to increase the efficiency of engines and boilers, the progress of invention is such that coal is becoming each year a more and more important article of commerce. So short a time ago, viewing the history of the world, as 1831, the annual coal production of Great Britain was 24,000,000 tons; for the year 1901 the coal production will probably be 240,000,000 tons, an increase of 1,000 per cent. In 1831 the population of Great Britain was 24,000,000, and the next census, 1901, will probably show about 40,000,000 in that country, an increase of 66 2/3 per cent. in 70 years. Therefore the production of coal has increased from one ton per capita to six tons, and the rate of increase has been 15 times as great as the rate of increase in population. The earliest statistics of coal production in the United States are very incomplete—in fact, prior to 1860 the output can only be guessed at; but such figures as are available show that in the United States, as in Europe, the increase in the use of coal has been phenomenal. In 1840 the production of bituminous coal in the United States was between 1,000,000 and 2,000,000 tons, and the production of anthracite was 1,000,000 tons—say a total of 2,500,000 tons. At that time the population of the country was 17,000,000, so that there was probably less than one-sixth of a ton used per capita.

Compare that with the present tonnage of 220,000,000 and a population of approximately 75,000,000, and it will be seen that America

is now using per capita eighteen times as much coal as she did sixty years ago. In fact, since 1890 the per capita increase has been 50 per cent. In that year and for some time prior thereto the coal requirements of the average community could be stated at two tons per person, but now three tons is the average for the country at large, and in all large places except the southern cities the average is above that.

First and foremost of the factors leading to this great increase in coal requirement has been the growth in the railway mileage at home and abroad. Such progress has now been made in the building of large locomotives that, counting in all the engines laid up for repairs, those temporarily in the shops, those in switching service and similar light duty, and those regularly employed on the road, it is found that some 1,600 tons of coal per annum are required for each locomotive in a company's service, on the presumption that the coal furnished is of good quality, and that the number of engines owned is great enough to make an average practicable. No more than ten years ago the average coal requirements of a locomotive did not exceed 1,000 tons a year. As there are now 40,000 locomotives in the United States and Canada* it will be seen that at least 64,000,000 tons of coal are annually required in this line of business, with the chances greatly in favor of a tonnage exceeding that amount. In fact, it has been claimed that one-half of the bituminous product of the United States (say 90,000,000 tons) is used by railways and steam vessels.

It is plain to all who give the matter more than passing interest that coal has come to the front, that it is in great demand the world over and that the United States is, at present, the coal cellar of the world. That it will become the coal *seller* of the world at an early date is a matter capable of mathematical demonstration.

Coal has always been high-priced in England. With the great prestige in manufacturing that the British people had for two generations in this century their manufacturers were ready and willing to pay high prices for their fuel. High prices were charged, and even though the business was conducted in a most crude and costly way, great fortunes were made by the coal proprietors of England, Scotland, and Wales. Properly conducted, the operations should have been comparatively economical, for the coal could be easily obtained: but now, after the lapse of a century of active mining, hundreds of millions of tons† have been extracted from the limited areas of Great Britain, and

* The large Canadian lines buy in the United States.

† It has been calculated that from the year 1600 to date 9,100,000,000 gross tons of coal or 10,101,000,000 net tons of coal have been produced in Great Britain.

it has come to such a pass that the high prices hitherto prevailing are absolutely required to meet the expenses of production and transportation, for now it is necessary to go deeper into the ground for the coal. Thinner seams have to be worked, the more attractive deposits having been exhausted. All the entries now are long, comparatively few new mines having been opened in Great Britain in the last ten years.

A moment's thought will make it plain that underground haulage and hoisting are enormously expensive methods of transportation, and that a certainty that these factors will increase in importance every day, as the coal industry grows older, makes it plain that the United States' coal fields, almost untouched as many of them are, grow steadily in advantage as regards the supply of the world. Generally speaking, there is not a coal mine in the seaboard bituminous regions from which coal has to be hoisted. It can in every case be drawn out in cars, sometimes up a grade, it is true, but quite as often the cars run down grade. Then, too, the American mines are generally new. All devices are contrived with the view of handling a large tonnage as economically as possible, and the present shipper of bituminous coal is not hampered by arrangements made years ago when trade requirements were less important. Very notable, too, have been the arrangements made by the railway companies for the transportation of coal. The tendency a few years ago toward lower prices caused the companies to scrutinize the matter of coal transportation with the utmost care, and the result is seen to-day in the almost scientific arrangements which have been made. The roads leading into the coal regions are solid and substantial, with grades and curves modified as far as the formation of the country will permit, and over them are operated trains of fifty 50-ton cars, drawn by huge slow-steaming locomotives. Owing to the allowance for extra weight generally permitted, the cars are often loaded to nearly 10 per cent. more than their marked capacity, making a consignment of 2,700 tons moved to market at one trip. The growth of the American coal trade will call for many additional branch lines into virgin territory, but the main lines of the coal-carrying roads are in excellent shape to carry an enormously increased tonnage. Probably with the addition of side-tracks to permit of the passing of passenger trains, the Norfolk & Western, the Chesapeake & Ohio, the Baltimore & Ohio, and the Pennsylvania could carry from 33 to 50 per cent. more coal than they are carrying to-day.

Another factor, little heard of but steadily operating towards increased production of coal, is the mining or coal-cutting machine. Tending as it does to displace manual labor to a great extent, the oper-

ators have usually hesitated to introduce it while their men were working satisfactorily, but when trouble has ensued and the men have held out stubbornly the introduction of mining machines has been one of the first incidents of resumption. By the use of mining machines it is possible to get out the coal with less breakage than results from ordinary hand mining and this is an important factor to those concerned in the export trade, for European consumers demand a lumpy coal.

For this reason, too, the coaling docks at which vessels are to be loaded for the export trade must also be built with closer regard to the prevention of breakage than is often the case at the present wharves. Small coal will burn as well as large, but as the European trade demands large coal they might as well have it, say the producers, as it can be furnished by the exercise of some little care and attention.

Having seen that there is an abundance of coal in the United States and that the facilities for transporting it to tide already exist, we find at present but limited facilities for ocean transportation. At this time, when the requirements of the United States government for transports to the East Indies and the West Indies have retired many American vessels from commercial pursuits, and when the great requirements of the British government for transportation to South Africa have taken 3,000,000 tons of vessel tonnage from the market, and general business activity has made miscellaneous freight plentiful for all vessels, it must be confessed that the average coal man, the owner of a few comparatively small mines, is at a decided disadvantage in regard to supplying the great export demand; but in so far as the large producing companies are concerned the question is by no means serious. Having ample resources, and operating in harmony with railway lines, with influential friends commanding ample capital, they will face the proposition as the Standard Oil Company took up the matter of exporting oil—not bidding against other shippers for the privilege of sending their merchandise in such steamers as might be at their disposal from time to time, but boldly starting in and building, without regard to subsidy or other political reasons, vessels designed expressly for coal-carrying, and for that purpose alone, though, to be sure, not unfitted for returning with any bulk freight offered.

It has been ascertained by interviews with thoroughly well-posted gentlemen in the ship-building and shipping business that a vessel having a cargo capacity of 7,000 tons would be best suited for this line of business, and that a speed of 10 knots is the most economical for such a vessel; faster time means more coal burned and slower time means fewer trips per year, so that 10 knots, which in practice will

allow for one round trip across the Atlantic and back each month, is found to be the most desirable speed.

It has been calculated by a careful compilation of figures that the cost of operating a 7,000-ton steamer to such an accessible port as Gibraltar, calculating the length of the voyage and time of unloading as 15 days, is as follows: Insurance, $875; interest on cost, $750; depreciation, $625; crew, $580; provisions, $168; port charges, $184; pilotage, $330; fuel, $2,025 (this allows full selling price for company's coal used for steam); with $100 for incidentals, we have a total of $5,637, making a cost of but 80.4 cents per ton for the actual transportation of the coal. Upon this basis the American product could be put in foreign markets at rates that would make competition simply impossible. Coal could be placed at Cardiff, the greatest coal-shipping port in the world, for $3 less than the present wholesale selling price at that place, even supposing that the vessel was destined to return empty and the producer doubled the above-mentioned freight.

Yet that is an extreme instance. It is not probable that an American producer would offer the coal at such a close margin, but he would seek to compensate himself for his expenditure incurred in the development of foreign trade by adding a dollar or two per ton to the cost price abroad, as determined by cost, insurance, and freight. Even on this basis, which gives him a $14,000 margin on a single cargo, there is $1 in favor of the United States seller at Cardiff and nearly as much at every other port in the northern portion of the eastern continent; and when it comes to supplying the trade of South Africa and South America, both important, there is also some 2,000 miles of sea travel.

Unfortunately, there are but few shipyards in the United States capable of building 7,000-ton vessels. The reduction in the price of iron and steel during the present year, the improvement of facilities to meet the home demand, and the undiminished strength of the foreign demand, all combine to strengthen the interest of American producers in the export trade. Undoubtedly the building of steam colliers will soon commence at all the shipyards capable of such work.

Studying out the capabilities of American ship-building plants we can estimate the growth of coal shipments from the United States. It would be thought that ship-building was flourishing indeed if, beginning with January 1st, 1901, a 7,000-ton collier should be launched every fortnight. That would mean 26 such boats in a year, or say 100 in four years. The United States would have an annual shipping capacity of say $100 \times 7{,}000 \times 12 = 8{,}400{,}000$, and it would not be at all surprising if the foreign trade of the United States equaled that

amount in the year 1905. In addition thereto American bunker trade will grow steadily in importance. The time is not long past when British vessels trading in American ports brought over enough coal to meet partially their requirements for the home voyage. Recently this practice has been reversed, and some steamers have even taken coal enough in America to carry them to England and back. The United States now supply 6,000,000 tons of coal to foreign steamers each year. It would not be surprising to see these figures doubled in five years.

In arriving at the above calculation we disregard shipments in tramp vessels, for some of the 7,000-ton boats would go on long voyages and would not be able to return in a month's time, and so the shipments in ordinary steamers would just about keep up the average. The building up of this great export trade has something more than an interest for the coal trade; it means the elimination of a troublesome surplus from the soft-coal markets of the United States, and prosperity and good wages throughout the mining regions. The million men and boys employed therein, or connected with local industries, under the auspices of good times, would buy so much more freely than at present as to have a decided influence upon the general business of the country. The railroads would be greatly benefited by the increased earnings. Three thousand or more seafaring men would find continuous employment on the coal-carrying vessels, and shipyards and builders of marine engines would feel the impetus of the great addition to the American merchant marine.

Nor will the benefit stop with the advantages derived from the mining and shipping of coal. Cheap fuel going abroad to countries now devoid of that blessing will lead to their development, American colliers will bring back the merchandise of those countries, and as developments progress markets will be found for manufactures of every description and from all countries. Now that the English have an undisguised preference for retaining their fuel supplies at home, it would seem to be in harmony with Anglo-Saxon brotherhood for the United States to succeed to a share in the export coal business. When it does come to pass that the United States supply the foreign nations with as much coal is England now supplies to them and to foreign-bound ships, some 55,000,000 tons in all, and gain such a return trade as England has gained, they will indeed be far advanced towards permanent prosperity, and will need to have no remedies proposed by political speech-makers. On a solid, substantial basis of great lumps of coal will rest one of the nation's most important industries.

NATIONAL IDEALS THE PRIME INFLUENCE IN IRON-TRADE DEVELOPMENT.

By H. J. Skelton.

IN the early seventies, when I was a youth in the drawing office of a large steel and iron works in Sheffield, the idea prevalent amongst young men in steel or engineering works, or such of them as had ambition or a consciousness of ability beyond the average, was that if there were not sufficient opportunity of fairly rapid and well remunerated advancement at home there was at least an opportunity outside old England in the great Republic of the west. From time to time one heard of migration of eager, spirited men, to the United States of America, where there seemed to be openings with an ample scope for mental and physical activity for all who cared to venture. It is somewhat piquant to reflect that much of the remarkable development that has taken place in American iron and steel industries may be due to the brains of those young men who could not find sufficiently good scope to satisfy their ideas, or sufficiently good pay to satisfy their ambitions, in Great Britain.

There are not a few people who think that the development of American iron and steel industries will not only shake the supremacy of Great Britain at home and in the markets of the world, but will change the entire European situation. This involves an enquiry as to whether Great Britain has lost ground, and if so, some enquiry why she has done so, and a consideration of the probable consequences of the new competition.

There is little doubt that Great Britain has lost ground. The progress and development of a nation depend in some considerable part upon the ideals or state of social opinion that obtain in the nation, quite as much as upon the possession of suitable raw materials of manufacture, the skill and capacity of its workers, and an advantageous geographical position. Economists on the continent of Europe have not hesitated to assert that a considerable portion of British

Mr. Skelton's article is remarkable for its appreciation and expression of the deep-lying relations of engineering work with the nation's political and social order. Engineers are sometimes indifferent to political and economic matters, but it is on such foundations that the whole fabric of their work rests. The sources of national tendency in constructive or productive enterprise are to be found, side by side with those of national character, in well-rooted ideals of law, education, and custom. Mr. Skelton, in reviewing competitive conditions in the most important branch of the engineering trade, goes direct to these fundamentals.—THE EDITORS.

supremacy in manufactures is due to the state of unhindered development that was possible in England, by reason of the conditions of peace within her borders. The conditions are certainly not favourable for successful manufacturing development if the factories of a country are liable to interruption, or even destruction, by sanguinary conflicts arising between nations territorially conjointed. Economists say, and say rightly, that England's long start in successful manufacture and the acquisition of riches would not have taken place if there had been periodical irruption of hostile feet within her borders, as on the continent of Europe. A feeling of comfortable security as regards interference from without not only produced a state of ease and wealth in England, but enabled her capitalists to undertake enterprises in all quarters of the globe to the benefit of the world at large. This feeling of ease, security, and supremacy was accompanied by certain disadvantages which may be briefly stated.

The landed interests in England, and in all European countries, have always regarded themselves as a caste apart from, and superior to, the other citizens of the State. A premium of social esteem has attached to the business of land owning, and to the pursuits and pleasures of land owners, which does not obtain with those having other occupations. A stigma, or an amount of social disesteem, is attached to those who do not belong to the land-owning class, or to its closely attached and dependent professions. These facts are of great importance since the landed interests have usually constituted the governing classes, with all the privileges and power that appertain thereto.

The natural heritors of the successful British manufacturers of the sixth and seventh decades of this century have in many instances avoided the responsibilities incidental to manufacture, preferring to play the part of a country gentleman and to engage in the delights of hunting, shooting, fishing, etc., rather than the less-attractive pursuit of commerce. To the state of social opinion hereby indicated may be traced the decay of many factories, which well-informed enterprise would have kept vigorous and prominent. It has also kept out of the ranks of manufacture many men of mental capacity, who by reason of their trained intelligence would have been capable of foresight, application, and enterprise that have frequently been lacking.

It is an obvious circumstance that while the world moves or while there is such a thing as progress in manufactures, the factory installed by the latest comer is usually better than any factory installed many years before. The new comer has the accumulated experience of his predecessors to guide him, which naturally places him in a

better position economically than those who have to put up with disabilities that accrue even in the passing of time.

England has built up her manufacturing position essentially upon handicraft—the skill of the individual worker has been the dominant idea amongst the masses of the English people. Their intense individuality has scorned the idea of mechanical aids to industry, quite as much for this pronounced characteristic as from any fear of supplanted or displaced wage-earning capacity.

The supply of skilled and industrious workers in British industries has usually been ample. The skill and capacity of the better-class individual English worker is on the whole to-day, in the iron, steel, engineering, and allied trades, not inferior to the skill and capacity of the worker in any other nation. But while the best brains of America have been devoted to the honourable pursuit of industry, to developing mechanical ingenuity, to guiding, governing, and giving all those general advantages which a trained intelligence confers, such has not been the case in England. There were in England not only conditions of luxury and ease, but social ideas hindering trained and organised manufacturing development.

The first of commercial nations has not had a system of education fitting her sons to engage in commerce. The curriculum of our great public schools and our great universities has succeeded in training men fitted for some of the learned professions, but as regards commerce, or most of the practical affairs of life, our young men have left the universities quite unfitted, and with the necessity forced upon them of learning all that was essential after their "education" was "completed!"

Given a state of luxury and ease, and a premium of social esteem upon members of any and all professions which did not obtain with the participants in manufactures and commerce, it is obvious to any sociological student that there must be loss of place in any struggle for world or social supremacy. When to this condition there is added a lulling sense of ease and comfort and an induced belief in the permanency of pride of place and power, a sense of individualism, and an ample supply of workers, it is not difficult to account for the present position of England.

Since the consolidation of Germany and something like an equal balance of military power in Europe the prevailing conditions of peace have permitted a steady and continuous growth of industrialism.

Nations, like men, first supply the wants of their own household before supplying others.

During the past twenty-five years England has suffered a relative decadence of trade, and has not such a proportionately large share of the world's trade as she had at one time. Competition from without did not seriously disturb the mass of Englishmen, while the national sporting instinct says in effect, "let all have a try and let the best man win."

It is no new thing for England to have competition in her iron and steel, and allied manufactures. Hitherto it has been called "foreign competition," and the success of foreign competition is popularly explained by the "brute force" element in commerce, low prices. The reasons for successful "foreign competition" have been placed under the heads of cheap transport, low wages, long hours of work, and peculiarities possible under a protective-duty system. Now that the competition from without is "American competition," coming from our own kinsfolk, coming from such a quarter, it excites amongst English people in general quite a different state of feeling from that which obtained in regard to European competition. The prevalent view in regard to Belgian competition was, and is, that its success depends upon a standard of living and of comfort amongst Belgian workers inferior to that of the British workman, and the results are products inferior in quality and workmanship to average British ideas. As regards German competition, although there were, and are, features in it undesirable of emulation, yet German workers were apparently better cared for than Belgian, and the enterprise of her manufacturers showed courage and perseverance, entitling German competition to respect. Enquiry has shown that on the whole German pig iron and the heavier iron and steel manufactures are not produced at lower costs than British. But when goods are sold below cost of manufacture for export, and the makers are compensated by high prices in a protected home market, which enable a recoupment of losses incurred in export trade, then a certain feeling of resentment is incurred. The average man settles the point in a common-sense way by stating in effect, "if other people like to tax themselves in order to supply sugar, or iron, below the cost of production, more fools they. This process cannot go on for ever, and in the meantime it is good business for the buyers or consumers anyway."

In order to estimate the effects of American competition it will be well to examine experience with other and preceding competition.

During the past twenty years the Belgian manufacturers of wrought iron have succeeded in taking from England a considerable share of the export merchant trade in wrought iron destined for mar-

kets over-sea, where the question of price is of more importance than the quality of the article produced. Everyone engaged in handling Belgian iron would be able to testify from experience that the manufacturers thereof had, over a period of years, left themselves too small a margin of profit for possible contingencies to be able permanently to satisfy buyers who expected anything like precision of weights and sizes, or regularity of quality in their supplies. In past years it has frequently happened that the price quoted for Belgian iron has been one pound (£1) per ton lower than the cost of any other iron obtainable on earth. It is clear that this considerable disparity in price indicated either the measure of value in the estimation of the buyers, or an economic struggle amongst Belgian producers themselves to secure such orders as were going. The careful enquirer would ascertain that the lower prices at which Belgian products were offered were obtainable only by a condition of long working hours and low wages, such as English employers in general would be unwilling to see adopted in their own works, and such as English workmen in general would never accept without a struggle of prolonged intensity. Recorded mercantile experience shows that Belgian bar iron and sheet iron are giving way in favour of German products. The rapid development of soft-steel manufacture by the aid of the Bessemer basic converter in Germany has led to German producers offering basic-steel bars in merchant sizes and shapes, and basic-steel sheets at prices equal to, and in some cases lower than, those of the inferior Belgian products in wrought iron. The natives of markets like India, China, and Japan, were prompt to discover that German soft-steel goods would work up better, and with less cracks, breaks, and failures than were common to Belgian wrought iron. The consignments from German steel makers were superior to those of Belgian makers, not simply in that superiority possessed by soft steel over low-grade wrought iron, but in greater regularity of working to lengths, sizes, and weights. The eastern importer found, for instance, that the outturn of a parcel of German steel was more likely to accord with the invoice than was the case over an average of transactions with materials of similar shape of Belgian origin.

It is necessary to dwell upon this phase of competition for markets external to England, because it illustrates what will probably happen in any successful American competition for the trade of neutral markets. American competition is already more feared in Germany and Belgium than it is in Great Britain.

Ordinary merchant trade is more readily acquired, or lost, than

that trade which is built up on specifications to meet engineering requirements, or in material ordered to comply with special conditions. On the engineering side I am doubtful of the ability of American steel masters to displace the use of British steel in structural work, where American suppliers claim a limit of phosphorus in their steel of .10, while British masters, in the open-hearth acid process, habitually work to a limit of .06. Every engineer knows that the lower phosphorus gives a better steel, safer in use, and will insist upon having low phosphorus while he can get it. Ordinary English steel-rail makers have no difficulty in working to a limit of .08 phosphorus. In higher-carbon steels, as now used for street and other rails, an English engineer will not accept a margin of 10 tons between the minimum and maximum breaking strains while he can get closer and better working. The tendency and the practice amongst English engineers is rather to raise the standard of quality than otherwise. Too much has been said, or presumed, as to the inferiority of British iron masters in blast-furnace practice. It is true that the out-put from particular American furnaces, working rich ores, is superior in tonnage to British practice working on ores with a lower content of metallic iron. But figures that have come before me, from time to time, show that in the best practice the "yields" are good, and that pig iron is constantly being made in England with no higher consumption of coke per ton of pig produced than obtains in best American practice. There is at least one district in England, working on English ore, in which, under normal conditions, structural steel can be produced at as low a cost as any figures at present obtained in America, while if the close contiguity of coal to the Lincolnshire iron field, which of late seems assured, is taken advantage of, there will be British iron and steel masters capable of holding their own against all comers.

From time to time politicians in England—usually very unsafe guides in commercial matters—will be found publicly urging British manufacturers to alter their methods of doing business. Consular reports are published pointing out the deficiencies of Britain in certain particulars. When close enquiry is made into their recommendations their notions are found to be largely based on an idea that Englishmen should lower their average standard of quality and workmanship, or that they should give extended credit to buyers in countries that have demonstrated in past years a financial inability to meet their engagements at due date. Every man who has had practical contact with workmen or manufacturers knows how difficult it is to

obtain from individual workers, or from an individual manufacturer, at one and the same time the best goods and the cheapest possible goods. In vain is it for those unfamiliar with details, or not in practical contact with manufacturing, to urge those who are engaged in producing to imitate their rivals or to embark on a trade in inferior goods. In practice manufacturers somehow get sorted out into grades suitable for particular markets, according to the nature and quality of their products. But England is now beginning to recognise that if she wants to keep and to extend her trade in British manufactures, she must find some means of diminishing the disparity in cost between her own products and similar manufactures of other nations. The English people are a watchful nation, whether in the small matters of domestic life or in the small economies of manufacturing life. England has been wasteful in not having developed her splendid possibilities by systematically educating and training her people. The commercial success which has been gained by scientific application and method in Germany, and the mechanical ingenuity of America, are the factors that are showing her how to economise in her methods and to cheapen her products.

So far as figures go, America will doubtless remain for some years to come the largest producer of iron and steel. But something more than quantity and cheapness of product is required, and that is, that these things shall be obtained with a general well-being on the part of the workers engaged. Amongst other things to the credit of America, let it be said that her mechanical genius and industrial courage are making Europe understand that there is a dignity attaching to human labour, that man is worth something better than to act as a beast of burden, and where mechanical devices can be employed to dispense with the use of mere muscular energy, such aids fit men for higher and nobler purposes, happier and more useful lives.

The future of European iron, steel, and engineering productions depends largely upon the ability to ensure continuous cheap supplies of suitable raw materials. America will doubtless contribute to the continuity of supplies of raw materials in the shape of pig iron, and "partly-manufactured" steel. It is probable that there will be an increase in the number of factories in England established on the seaboard in suitable districts, at which American pig iron, soft steel in blooms, billets, slabs, and bars, can be worked up and turned into various products to meet constantly-growing needs of home and foreign markets. The ability to obtain such supplies from America will no doubt steady prices and prevent violent fluctuations in values in

Europe. Machinery and tools, from the United States, where they specialise and promote intensity of production, will be bought and adapted in various ways to the special and local needs of European users.

German methods and American ideas are modifying British practice and British ideas in manufactures and commerce.

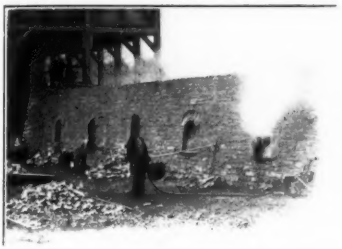
There is an anecdote told of two men, a German and an Englishman, who were discussing military matters somewhat energetically. The German clinched his argument by saying: "I tell you if a war were to break out all Germany would fight like one man." To which the Englishman replied: "And I tell you, if a war were to break out every Briton would fight like all England." This anecdote may be taken to illustrate the difference in mental attitude between England and her chief commercial rival. Englishmen learn with difficulty to combine amongst themselves to a common end, or to exchange information for the common good. Their respect for individuality is carried to extremes. More weight is attached to opinions than to the ascertainment of facts. But earnest and capable reformers are struggling to secure a scientific basis for the education and training of the people.

The most successful profit-making British works are those where trained commercial intelligence dominates "practical" men, who are, however, invaluable in their properly subordinate positions. All these things are gradually being understood, and as they are more widely understood, will give rise to a feeling of dissatisfaction with the old men, the old methods, and the old factories which have outlived their period of usefulness.

American mechanical genius and cheap steel will not only raise the standards of comfort, but will multiply the wants of civilised mankind, which consumes more iron per head of population year by year. But in seeking to create and sustain an export trade in steel, America will find Belgium and Germany her most formidable competitors—particularly Germany, whose manufacturers thoroughly understand the art of combination to insure immunity from external competition. During the past ten years there has been a striking increase in the number of factories throughout Germany, which are boldly conceived, well-planned, and fitted and intended to last.

American competition will be more successful in British colonies, dependencies, and in neutral markets generally than in Great Britain itself, where it will act as a health-producing tonic that England has wanted for many a day.

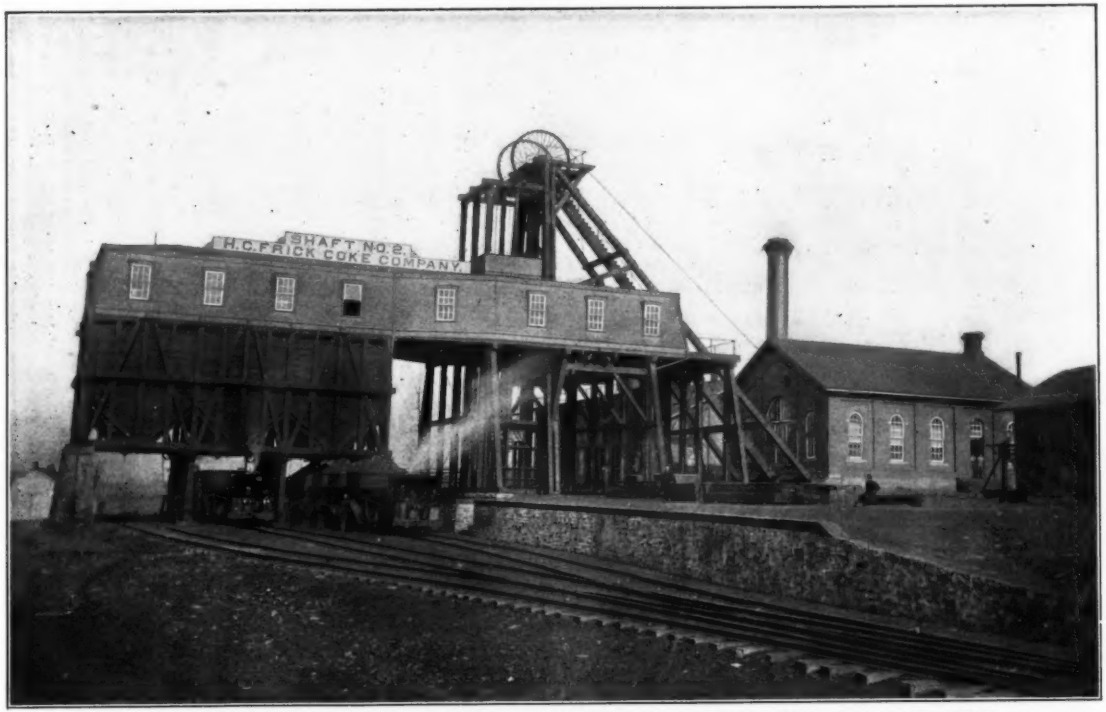
THE CONNELLSVILLE COKE REGION.



IT is said that when Mark Twain passed through the Connellsville coke region, he remarked that "it looked like hell with the lid off." Other people have, perhaps, not expressed themselves so warmly or so positively, but they have in some way conceived that the Connellsville coke region is a most disagreeable section; in fact, the general opinion, except among those who have ascertained by personal investigation, seems to be that those portions of Fayette and Westmoreland counties that are the seat of the greatest coking operations on the face of the earth are a wild, desolate country, inhabited by a race of beings but little removed from the status of the savage. I am ready to admit that a ride by rail through the region when the coking industry is at high-water mark is anything but prepossessing, and is apt to give impressions that are far from the truth. It should be remembered that the railroads, as a rule, follow narrow valleys lined with rows of smoking coke ovens, while, perhaps, but a few hundred feet away over the hills are to be seen rich and beautiful landscapes.

The facts are that the Connellsville coke region is one of the most beautiful sections of southwestern Pennsylvania. It is not only rich in the mineral that is now one of the factors, if not the factor, that makes possible the supremacy of a nation, but it is rich agriculturally. Its wide valleys and rolling uplands yield a wealth of grasses, grains, and fruits that is unrivalled by any other section of the United States; in proof of which the view of the Mount Braddock farm of the H. C. Frick Coke Company will speak for itself. It is historic ground—the land of Nemacolin, the Indian warrior; through it passes Braddock's road, near which the unfortunate general was buried after the

The three great factors in America's rapidly-won prominence in iron and steel making are fuel, ore supplies, and labour economy. It would be hard to rank them in their true order of relative importance, but just now the newest and keenest interest centers in the study of the coal resources of the United States. We are glad to be able to present this comprehensive review of the region which has chiefly supported the vast American iron and steel trade—a review by one of the leaders and managers of the progress of the Connellsville region—as a concrete supplement to Mr. Saward's general discussion preceding.—THE EDITORS.



MAIN HOISTING SHAFT, STANDARD COKE WORKS, MT. PLEASANT, PA. THE LARGEST COKE PLANT IN THE WORLD.

disastrous reverse to the British arms at Braddock's field, July 9, A. D. 1755. The great national pike from Cumberland to Wheeling, which has been likened unto the Appian Way, passes through its heart; and it is watered by the tributaries of the Monongahela and Youghiogheny, supplying it with the finest of water from the springs of the Alleghenies, which is of the greatest importance in coke making, as it requires large volumes of pure water to pro.luce a first-class article of coke.

Within the outlines of this coking coal field there are three important towns, or rather, young cities, viz: Uniontown, the county seat of Fayette county, Connellsville, and Scottdale. There are also a

THE MOUNT BRADDOCK FARM, H. C. FRICK COKE COMPANY'S PROPERTY.
Showing the character of the country overlying the Connellsville coal basin.

score or so of smaller places, all of which are to a great extent the result of the development of the coking industry.

The Connellsville coking-coal field proper is of limited area and extends from a point near Latrobe, on the Pennsylvania Railroad, in a southwesterly direction through Westmoreland and Fayette counties, a distance of 42 miles, almost to the Virginia line, with an average width of 3½ miles, covering an area of 147 square miles, and, excluding barren measures, originally contained 88,000 acres, of which there are (I will say January 1, 1900), as near as I can ascertain, about 62,000 acres of available coal yet to mine. At the present rate of production, this coal would last fifty years; but if it should

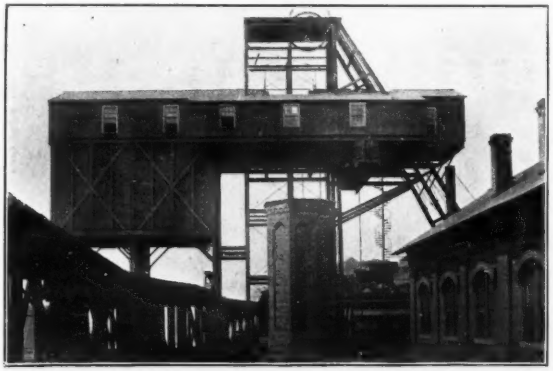
increase in the ratio that it has in the past ten years, it would be exhausted in twenty-five years.

May 1, 1900, there were in operation in this region 89 plants, embracing 20,263 coke ovens, all of which are of the bee-hive type, excepting 50 Semet-Solvay ovens, which are being operated by the Dunbar Furnace Company, of Dunbar, Pa., for the production of coke and the recovery of the by-products. Of the 20,263 ovens, 19,751 were in full blast and 512 out of blast; 72 of the latter were under construction, and the remainder idle from various causes—principally lack of coal. The 19,751 ovens in blast were at that time producing coke at the rate of 225,000 tons coke per week, or about 13,000,000

OLIVER COKE WORKS, OLIVER, PA.
Second largest coke plant in the world, having 708 ovens. Owned by the Oliver & Snyder Steel Co.

tons per annum. This is a great increase in production over last year, which was 10,129,764 tons; however, it is not likely that this pace will be kept up the whole year—in fact, there are already evidences of a lessened demand in the near future, owing to the falling off in consumption of iron and steel.

In the Connellsville coke region proper there are quite a number of new plants under construction, which, when completed, will bring up the total number of ovens to something like 23,000. In addition to this, there are a number of plants under construction in what is known as the "Klondike" region, which is just outside the limits of the Connellsville field proper to the southwest. These plants, when completed, together with those projected, will embrace about 4,000 ovens, which, added to Connellsville field ovens, will make a grand total of 27,000 coke ovens in Fayette and Westmoreland counties. Just what will be the result of all this expansion is somewhat of an uncertainty, but it would seem to be indicative of a rocky road ahead to those not making a high-grade coke, which so far the Connellsville region has had a monopoly of, with good prospects of holding it.



Leisenring Shaft, steel head frame, and ram.
Oliver No. 2 Shaft, and group of workmen.

Steel head frame and portion of coke plant, Leith Shaft.
United Shaft, H. C. Frick Coke Co.

SHAFTS IN THE CONNELLSVILLE COKE REGION

GROUP OF COKE DRAWERS, YOUNGSTOWN COKE WORKS.
From a photograph taken nearly 20 years ago.

This is a fair statement of the present condition of the industry. Prices paid for coke during the twelve months up to May, 1900, have been good, and the operators have shared with their workmen the prosperity that has fallen upon them by voluntarily advancing wages twice during the period. The scale of wages now in force is the highest ever known in the Connellsville coke region, and as a natural consequnce there is a general boom in all lines of business.

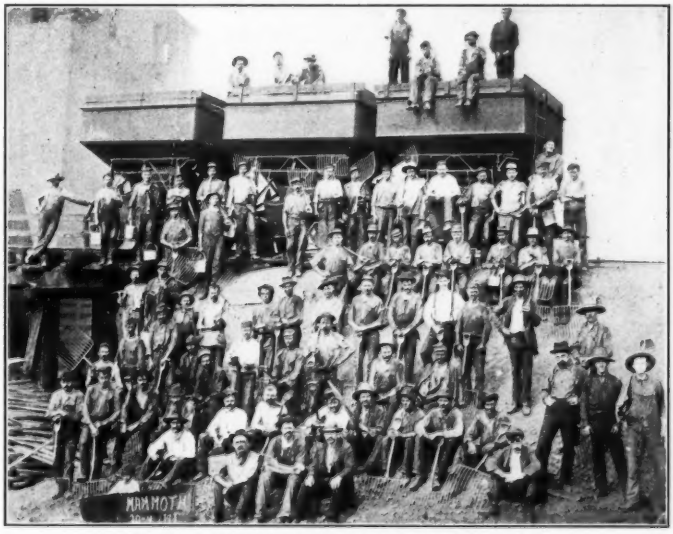
The growth of the Connellsville coking industry is phenomenal, and a brief account of its inception and progress will doubtless prove of value to all interested in the iron and steel industries of the State. It is my good fortune to be a fellow townsman and an acquaintance of Mr. M. M. Cochran, President of the Washington Coal and Coke Company, of Fayette county, Pa., whose very extensive operations are located upon a tract of land formerly owned by George Washington, from which fact they take their firm title.

Mr. Cochran is a son of Mr. Mordecai Cochran (the real father of the Connellsville coke industry), and I have direct from his lips the following modest but very concise and reliable statement:

"Mordecai Cochran, in the year A. D. 1843, built two boats on the banks of the Youghiogheny river near Dawson, Fayette county, Pa. During the course of their erection, he made an arrangement with

Sample Cochran and James Cochran by which, in consideration of their contributing their labor in the building of the boats in question and in the manufacture of sufficient coke to load those boats, they were to have a one-half interest in one boat.

"Mordecai Cochran was a prosperous farmer and owned 300 acres of land, much of which was underlaid with the now famous seam of Connellsville coking coal. He, therefore, had within his own grasp all the facilities for the successful mining of coal, the manufacture of coke, and the means of transporting (the Youghiogheny river) the same to a market. The young men, Sample and James Cochran, helped to build the boats in question, mined the coal, manufactured the same into coke and loaded it in the boats, and these were floated down the river to Cincinnati, Ohio. Upon the arrival there, Mordecai Cochran went to see Miles Greenwood, the principal iron manufacturer and foundryman of the west. Mr. Greenwood said that he did not need the coke, and seemed to have doubts of its value as an iron-smelting fuel; however, Mr. Cochran finally persuaded him to send carts down to the wharf for enough coke to make a test. These carts were loaded with coke free of charge and the test was made immediately. Greenwood was greatly surprised at what he termed the wonderful heat of the strange fuel and the ease with which it melted the



GROUP OF COKE DRAWERS AT THE MAMMOTH WORKS.

STEWART COKE WORKS, UNIONTOWN, PA.
Showing coke ovens under construction.

pig iron, and he at once purchased the remaining coke at a very fair price. He told Mr. Cochran to go home and make all the coke he could."

This, without a doubt, was the great commission to initiate the manufacture of Connellsville coke and ship it as an article of commerce. It was the formal and complete introduction of it as an iron-smelting fuel, and from that time to this there has never been the slightest doubt as to the superiority of Connellsville coke over all other iron-smelting fuels. Until Mr. Cochran gave away those cart-loads of Connellsville coke its value was unknown, and to him should be given the title of "the father of the Connellsville coking industry."

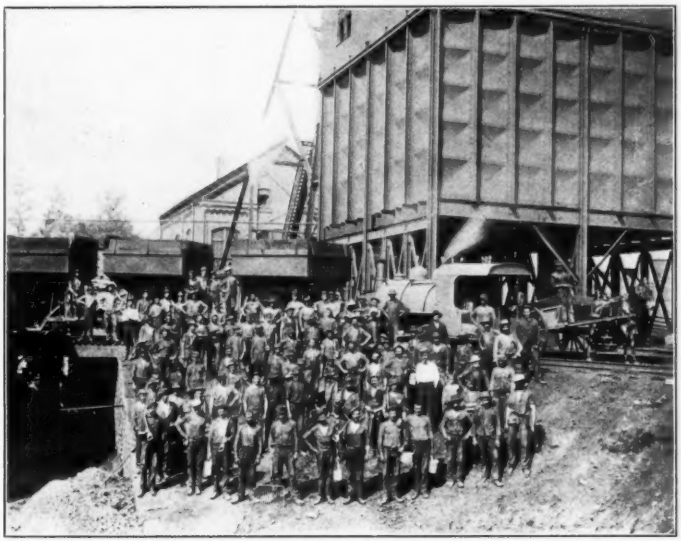
The coke made by Mr. Cochran was manufactured on the site of the old Fayette Coke Works, above Dawson, Pa. These pioneer works of the region were commenced about 1850, and were abandoned many years ago.

There are no records of the amount of coke manufactured, etc., in the Connellsville coke region previous to the year 1880, so that I cannot do more than annex a table of the yearly production, etc., since that date:

TABULATED STATEMENT OF CONNELLSVILLE COKE PRODUCTION, ETC.

Year.	Total Ovens.	Tons Shipped.	Av. Price.	Gross Revenue.
1880	7,211	2,205,946	$ .79	$ 3,948,643
1881	8,208	2,639,002	1.63	4,301,573
1882	9,283	3,043,394	1.47	4,473,889
1883	10,176	3,552,402	1.14	4,049,738
1884	10,543	3,192,105	1.13	3,607,078
1885	10,471	3,096,012	1.22	3,777,134
1886	10,952	4,180,521	1.36	5,701,086
1887	11,923	4,146,989	1.79	7,437,669
1888	13,975	4,955,553	1.19	5,884,081
1889	14,458	5,930,428	1.34	7,974,663
1890	16,020	6,464,156	1.94	12,537,370
1891	17,204	4,760,665	1.87	8,903,454
1892	17,256	6,329,452	1.83	11,598,408
1893	17,513	4,805,623	1.49	7,141,031
1894	17,834	5,454,451	1.00	5,454,451
1895	17,947	8,244,438	1.23	10,140,658
1896	18,351	5,411,602	1.90	10,282,043
1897	18,628	6,915,052	1.65	11,409,835
1898	18,643	8,460,112	1.55	13,113,179
1899	19,689	10,129,764	2.00	20,259,528

An inspection of the foregoing table will reveal the fact that in twenty years the production of Connellsville coke has increased from 2,205,946 tons to 10,129,764 tons, or nearly five times the production of 1880. A further examination of the table will show that the Con-



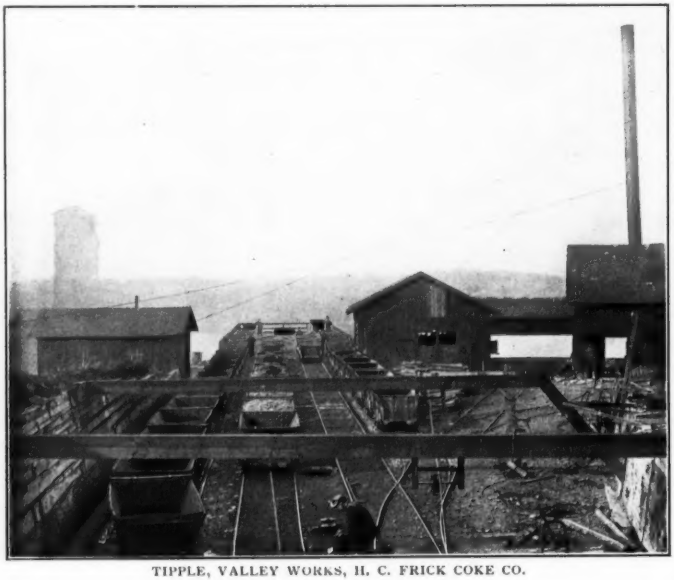
OLIVER NO. 2 SHAFT AND GROUP OF COKE DRAWERS.

nellsville coke region has had its ups and downs—periods of great depression as well as periods of prosperity.

The following table will show the rates of wages paid from 1894 to the present time:

TABLE SHOWING PRICES PAID FOR COAL MINING AND COKE DRAWING.

	Jan. 1, 1894	Apr. 1, 1895	Oct. 1, 1895.	Jan. 1, 1896.	May 1, 1899.	Mar. 1, 1900.
Mining and Loading Room.....						
Coal per 100 bushels...	.75	.90	.95	1.05	1.12½	$1.25
Heading coal.....	.86	1.02	1.08	1.20	1.27½	1.40
Wet heading coal.....	.91	1.10	1.16	1.25	1.32½	1.45
Drawing coke per 100 Bu. coal charged.....	.43	.50	.53	.60	.64	.72
Levelling per oven....	.07½	.09	.09½	.10¼	.10½	.12
Drivers, roadmen and timbermen, per day.	1.55	1.89	2.00	2.10	2.12½	2.35



TIPPLE, VALLEY WORKS, H. C. FRICK COKE CO.
Drift or water level type of mine.

The advances of April 1, 1895, Oct. 1, 1895; Jan. 1, 1896; May 1, 1899, and March 1, 1900, have all been voluntary on the part of the operators. I doubt very much if such an array of voluntary advances can be shown in any other industry.

The mining rate shows an advance of 66 2/3 per cent., the coke-

drawing rate an advance of 67½ per cent, and the day-work rate an advance of 51½ per cent. since March 31, 1895, making an average advance of over 61 per cent. in four years' time.

The seam of Connellsville coal, which is the basis of all this wonderful progress and gratifying prosperity, is one of the most remark-

COAL MINER AT WORK, VALLEY MINES, CONNELLSVILLE SEAM.
Showing full 9 feet of workable coal.

able in the States, if not in the world. It is pre-eminently a coking coal. There is no other seam that can compete with it in cheapness of production. There is no other coal so regular in formation; so uniform in quality; of so convenient a thickness (8 to 9 feet), or so easily mined. These are not mere statements, but facts—facts that have made Pittsburg the steel center of the world, and facts that in thirty years have been the means of bringing up the output of the blast furnaces of the United States from 30 tons per day to more than 700 tons per day. The following tables will show the quality of this coal.

The samples in the second table (p. 28) were taken from the Oliver mines by me and cover the full thickness of seam worked. The samples were analyzed at the Hainsworth Steel Works.

It should be remembered that a considerable percentage of the sulphur in the Connellsville coal is volatilized and driven off in the

coking process; therefore, the resulting coke is much lower in sulphur than the coal was before undergoing the operation of coking.

ANALYSES OF CONNELLSVILLE COAL, AS GIVEN BY U. S. GEOLOGICAL SURVEY.

Mine.	Fixed C.	Volatile M.	Ash.	Sulphur.
Henry Clay	61 49	32 40	5.10	1.01
Frick	60.92	32 60	5.40	1.08
Valley	63.78	30.60	4.50	1.12
Trotter	63 34	30.20	5.40	1.06
Eagle	62.68	27 90	7.50	1.92
Summit	59 80	33.80	5.40	1 00
Tip Top	60 90	32.10	5.60	1.40
Morgan	58.10	33 60	7.10	1.20
Foundry	65 36	28 40	4.90	1.34
White	63.30	28.80	6 80	1.10

ANALYSES OF SAMPLE OF COAL FROM OLIVER MINES.

	Moisture.	Fixed C.	Volatile M.	Ash.	Sulphur.	Phos.
Oliver	.800	66.35	26 70	5.35	.80	.015
Oliver	.350	61.17	31.70	6.00	.78	.016
Oliver	.600	63.10	29 50	5.85	.94	.014

The following tables of Connellsville coke analyses are a fair exponent of the product of some of the plants of the region:

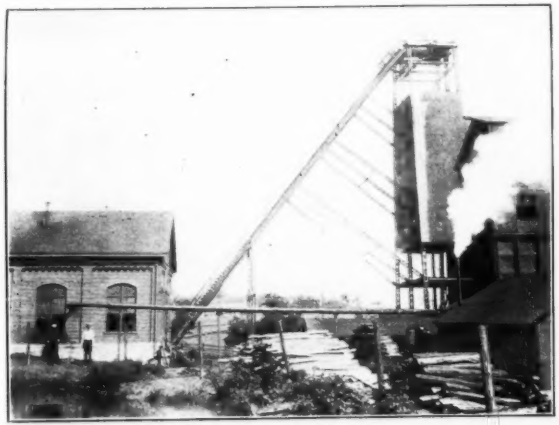
	No. 1.	No. 2.	No. 3.	No. 4.
Water	.030	035	.036	.037
Volatile Matter	.645	.605	.535	.530
Fixed Carbon	89.405	89.740	89.359	89.733
Sulphur	.678	.673	.877	.636
Phosphorus	.013	.011	.010	.008
Ash	9.229	8.936	9.183	9.056
	100.000	100.000	100 000	100 000

No. 1 was 24-hour coke. No. 2 was 48-hour coke. No. 3 was 72-hour coke. No. 4 was 96-hour coke.

The coke from which the samples were taken for the above analysis was made by me at the Oliver Coke Works some years ago.

The following was given to me as the average analysis for three years of coke from the Connellsville coke region:

Volatile Matter.	Fixed Car.	Ash.	Sulphur.	Phos.
.60	88.70	10.80	.900	.018



Oliver No. 2 Shaft.
Another Oliver No. 1 Shaft.

Oliver No. 1 Shaft.
Henry Clay Tipple and Slope.

SHAFTS OF CONNELLSVILLE COKING-COAL MINES.

This is a very good showing, as it covers hundreds of samples from scores of plants all over the region. Of course, picked samples would show much better; in fact, I have seen picked samples of Connellsville coke that ran considerably over 90 per cent. carbon, but the above is good enough to satisfy the most exacting furnace operator.

A prominent blast-furnace man tells me that he wants coke to run not less than 85 per cent. carbon; not over 10 per cent. ash; not much over .75 per cent. sulphur; range of .010 to .020 phosphorus. These specifications can be easily filled by Connellsville coke.

It is true that the above chemical constituents can be supplied by much of the coke manufactured outside of the Connellsville region, but there are physical requirements (as well as chemical ones), and Connellsville coke invariably possesses these. It is further true that outside cokes, on analysis of picked samples, often exhibit a higher percentage of carbon and a lower percentage of ash, sulphur, and phosphorus, but they do not possess the necessary burden-bearing capacity, cellular structure, or uniformity. Perhaps the one great merit of Connellsville coke is its uniformity—it averages up well; that is what the iron makers want—high average results, not an occasional phenomenal showing. The fact that a certain coal can furnish a very pure coke, high in carbon, is not so satisfying as the fact that another coal does furnish a coke that is pure enough for his purpose and he can depend upon its being so always.

In the earlier days of the industry, the incentives for economical and exhaustive mining were not great. Large areas of the coal lay above water level, much of it with comparatively light cover, and of an inclination that furnished natural drainage and grades in favor of the load haul—a state of affairs presenting few or no difficulties to a mining proposition, and requiring no great outlay of capital for mine development or expensive openings, timber, etc. These conditions, together with the fact that Connellsville coal at one time sold at the ridiculously small sum of $12 per acre and for many years remained less than $100 per acre, gave the earlier operators the false idea that it was immaterial whether coal was exhaustively mined or not, and the result was that the mining was done in the crudest way and fully one-half of the coal area mined over in the earlier mines was lost. The mines were often opened up on the single-entry plan; the entries were of the most temporary character, and both these and the rooms were driven haphazard; there were no regulations as to width of rooms or pillars, and ventilation and mining engineers were regarded as expensive superfluities.

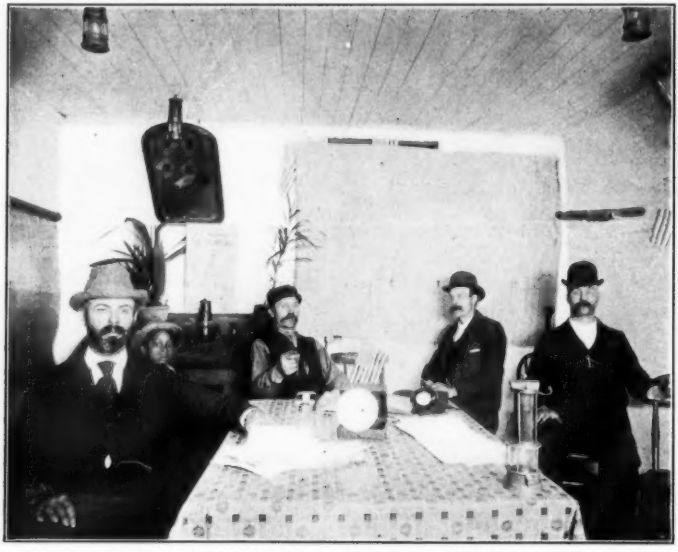
The earlier operations were of necessity of small capacity; therefore, skill and definite systems of mining were not essential to success, or at least, that which was viewed as success in those days. It was not until extensive operations became a feature of the industry that skill, definite systems of mining, machinery, and mechanical and mining engineers were considered factors at all; even then, if it had not been that coal lands became enhanced in value and the coal seam had to be attacked below water level, with adverse grades, mechanical drainage and ventilation, expensive openings, heavy cover, and immense volumes of water and fire damp to contend with, there would have been no strenuous attempt made to obtain from the seam the greatest possible yield and results. With these conditions imper-

BOTTOM OF OLIVER NO. 1 SHAFT.

This shaft is the second deepest in the Connellsville region, and the mine the most gaseous yet opened.

atively confronting the operator, a radical change took place in the operations, methods, and appliances. Coal lands advanced in price from $12.00 per acre to $1,000, and at this day even $1,500 per acre is not thought a prohibitive figure. The drift mines, with their single entries, natural drainage and ventilation, mule motive power, and an output of a hundred tons or so per day, gave way to immense plants, such as the Standard Shaft mine of the H. C. Frick Coke Co., at

Mount Pleasant, Pa. (the largest coke plant on earth), with its batteries of 908 blazing coke ovens consuming daily over 3,000 tons of coal and turning out daily 125 carloads of the silvery fuel that fears no rival. There, the drift or adit is replaced by the shaft that pierces hundreds of feet vertically the rocky stratum that but a few years ago was thought to seal from man its treasure of black diamonds. The mule is replaced by enormous engines; natural drainage by huge pumps; natural ventilation, by powerful fans; the hand dump, by the steam ram or pusher; and the lard-oil torch, by the electric light. Single entries are replaced by double and triple entries, and they and the rooms and pillars are laid out and driven with mechanical precision.

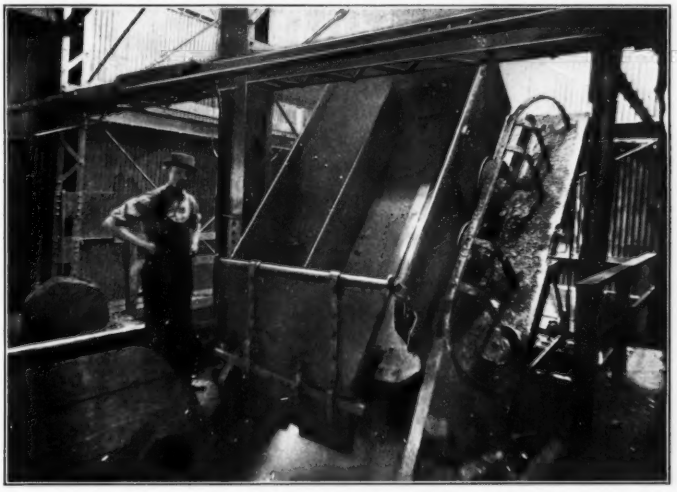


MINE FOREMAN'S OFFICE, 430 FEET BELOW THE SURFACE, OLIVER NO. 1 SHAFT.
(Mr. Keighley is on the left of the group.)

There are many fine operations among the 89 establishments that are marshalled under the generalship of the leaders of this great industry, but the space allotted forbids a description of all, and I shall attempt to outline only one more of the giant plants, and that one will be the Oliver Coke Works of the Oliver & Snyder Steel Co., located at Oliver, near Uniontown, Fayette county, Pa. (See page 20.)

This plant, with its battery of 708 coke ovens, is the second largest

in the world, and it is to a very great extent the result of the energy and foresight of Messrs. H. W. and George T. Oliver, prominent iron and steel manufacturers, of Pittsburg—the latter at the present time the proprietor and editor of the *Pittsburg Commercial Gazette*, Pittsburg, Pa. The mine workings are reached by two shafts, 415 feet and 387 feet, respectively, in depth. The workings proper were de-



TIPPLE HOUSE AND CAGE LANDING, OLIVER NO. 2 SHAFT.
Car just dumped, and still in position.

veloped under the six-heading system, *i. e.*, six parallel entries, protected by pillars of coal 600 feet in total width. The mine workings cover an area of 900 acres, which are, in turn, connected together by 46 miles of entries. The total area of the coal field at present tributary to the mine is 1,400 acres, leased from the estate of William Thaw, deceased, and more will be added when required. The coal is hauled from the various gathering points by two endless cables aggregating more than 20,000 feet in length, and a gravity plane is nearing completion that will be 10,000 feet in length; 700,000 gallons of water are pumped daily from the mine workings by the largest Yough pump ever made by the manufacturers (Boyts, Porter & Co., Connellsville, Pa.). The steam cylinder of this pump is 36 inches by 48 inches. The ventilation is effected by two Guibal-type fans 10 and 20 feet in diameter, respectively, moving nearly 300,000 cubic feet of air per minute. An extra 10-foot Guibal fan is held in readiness to

start up at any time emergency may require it. Forty head of horses and mules are kept at all times for use in the workings, and the same are stabled underground in stables built of brick and cement. The main headings of the mine are lighted by electricity, more than 300

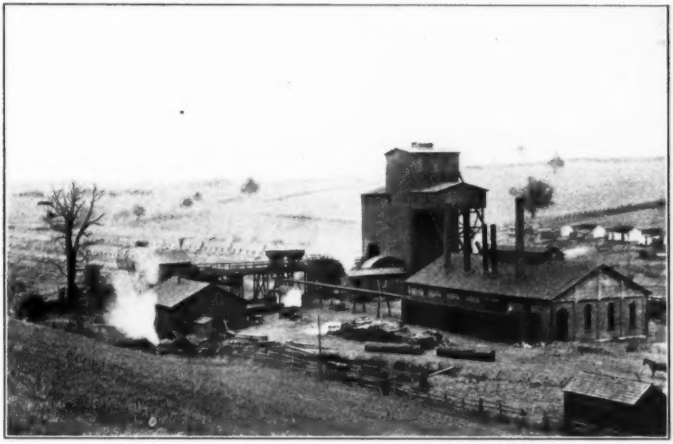
TIPPLE HOUSE AND CAGE LANDING, WITH AUTOMATIC DUMPING CAGE, OLIVER SHAFT NO. 2.

incandescent lights being in constant use about the plant. The workings are piped with fresh water supplied by pumps located on the bank of the Youghiogheny river at Connellsville, nearly 13 miles distant, and thrown over an elevation of nearly 600 feet. More than 300,000 gallons of fresh mountain water are consumed daily upon the premises.

The output of the mine averages 70,000 tons of coal per month, and the capacity of the coke ovens is 500,000 tons per annum. The shipment of coke from this plant for May of this year alone was 42,400 tons. Nearly 500 men are employed in the mine and 350 outside on the coke yards, etc., making a total of 850 men, with a monthly pay-roll exceeding $40,000. The cost of the plant is considerably more than $1,000,000.

The Oliver mines have been very difficult to operate, owing to immense volumes of fire-damp generated within the workings. Outbursts of fire-damp have occurred several times. On one occasion the fire-damp reached to the top of the shaft and for twenty-four hours it was impossible to go down the shaft. At another time, an

outburst filled the mine workings with fire-damp for a distance of 500 feet horizontally from the face in less than an hour's time. Three times during the life of this mine has it been necessary to tap the mine workings by means of bore-holes from the surface; yet during the whole of the nine years the mine has been operated, there has never been the slightest accident from fire-damp. This is in all probability largely due to the prohibition of the naked light and the rigid inspection enforced daily, no matter whether the mine is operated or not. The naked light was only used one day, and that was the first day the mine was operated. A force of five certificated fire bosses examine and report on the condition of the mine before a workman is allowed to enter. All underground employees work with a locked safety lamp, which is examined and locked each morning before being handed to them; however, much the same is true of all the more extensive workings of the Connellsville coke region, as fire damp is generated in enormous quantities in all the deep operations, and several of the mines have been the scene of appalling and heartrending accidents—for instance, The Reid Uniondale Mine, Leisenring Shaft No. 2, Youngstown Slope, Hill Farm, and Mammoth Mines.



MAMMOTH COKE WORKS. THE SCENE OF A GREAT ACCIDENT ABOUT TEN YEARS AGO.
The writer of this article was superintendent of the mine, and was within twenty feet of the shaft mouth, having just ordered a cage to go down on, when the explosion occurred.

Of late years, owing to greater care, better methods, more efficient appliances, and rigid inspection, accidents from fire damp are rare within the confines of the Connellsville seam.

Those accidents, while dreadful of themselves, have been productive of much good, and to them may be traced the present mining laws of the bituminous-coal districts of the State of Pennsylvania. Before these accidents occurred, few dreamed of danger from fire damp in the Connellsville coke region, and I, in common with many other managers, for years went about work with a flaming torch in mines that are now worked exclusively with the locked safety. The accidents occurred mostly in presumed non-gaseous mines. For many years it was presumed to be an established fact that all coal mines above water level were non-gaseous, but some of the greatest explosions of late years throughout the States have occurred in coal mines above water level, though in the Connellsville coke region the fire-damp accidents have invariably occurred below water level.

The types of safety lamp now in use in the Connellsville coke region are as follows, viz.: For examination of the working places by fire bosses, inspectors, etc., the Davy lamp is almost invariably used, though occasionally types of the Clanny lamp are used for that purpose. For the workmen, the Clanny type, bonnetted and unbonnetted, is largely used. The best lamp yet introduced is the Wolf lamp. This lamp has many good features, some of which are as fol-

THE HILL FARM MINE FIRE. TAKEN THE DAY OF THE GREAT ACCIDENT, JUNE 16, 1890.

Thirty-one lives were lost. The dark portion of the engraving, on the left, shows the smoke over the pit mouth.

MAHONING MINE. WHENCE RELIEF HEADING WAS DRIVEN INTO THE HILL FARM MINE AT THE TIME OF THE ACCIDENT THERE.

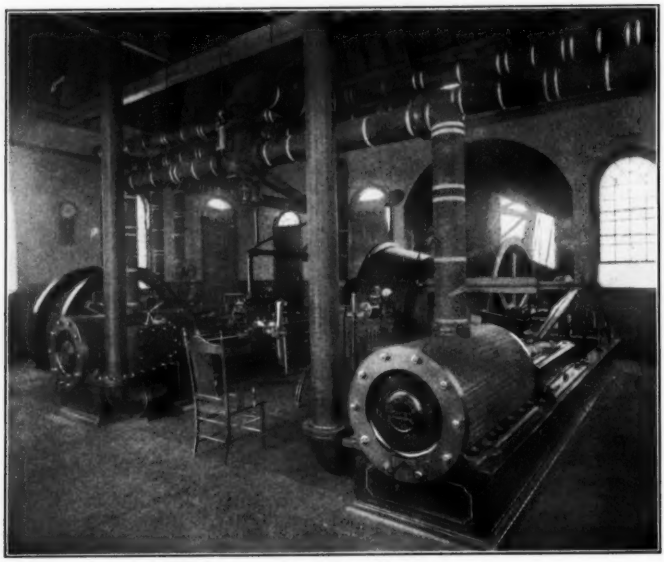
It was found to be impossible to reach the bodies by this route, and an exploring party of three, led by the writer of this article (who was mine inspector), penetrated over a thousand feet into the Hill Farm workings.

lows: It is always self-extinguishing in the presence of fire-damp, in explosive mixtures, or in case of being overturned; it is provided with a magnetic lock that cannot be picked; has an igniter by which the lamp can be lighted without opening it, and it gives a good light.

The ventilation of the mines is effected by means of furnaces and fans, principally fans, which are of the Guibal and Capel type—the latter being the coming fan.

The hoisting machinery is of the most substantial build, and almost always of the first-motion pattern, with differential drums at the shaft mines. At slope mines the machinery is both of the first-motion and geared patterns, with various forms of friction clutch. The pumping appliances are operated both by steam and compressed air, and include a variety of direct-acting patterns in single, duplex and compound noncondensing types of cylinder and plunger pumps.

Steam is generated principally by two-flue, fire-tube and water-tube boilers, with a tendency to the general adoption of the latter class with the vertical arrangement of the tubes, in preference to the horizontal and diagonal alignment. The tippling of the coal is largely done by automatic or self-dumping cages and the steam ram, though



HOISTING ENGINE, LEISENRING SHAFT NO. 2.

at slope mines the tippling is accomplished principally by means of drop-bottom mine cars and inclined trestling provided with a large bin placed immediately under the mine-car tracks. The coal mining is all done by pick-work; as yet, machines have failed to perform this work satisfactorily. The coal is very easily mined by hand.

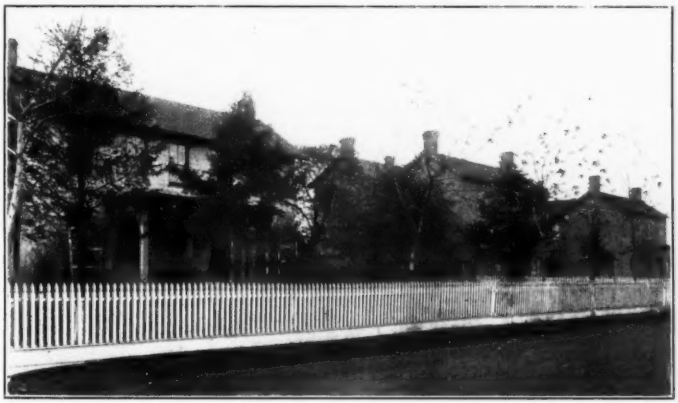
The hauling of coal underground is largely done by some form of tail-rope or endless-rope haulage. At the Leisenring shaft No. 1 of the H. C. Frick Coke Company, compressed-air locomotives have been installed at a cost exceeding $20,000, and are said to be giving most excellent results. These locomotives are of the high-pressure type, using air at a pressure of 500 pounds per square inch (manipulated by a form of reducing valve), and are very compact—quite a contrast to, and a great improvement over, the cumbersome low-pressure machine in use at mines heretofore. This, I believe, is the first attempt to use the compressed-air locomotive in the mines of this region, and it is viewed with greatest interest by the operators and mining talent generally.

Electricity is largely in use for stationary lights at the principal points about the mines and in the various buildings.

The mine workings are now developed by the two, three, four,

five and six-entry systems of mining. All the working places are driven on sights, *i. e.*, on lines given by the mining engineer. In some of the mines the retreating system of working has been adopted, and the aim is now to recover all the coal as nearly as possible. The most skillful mining-engineering talent is employed, and coal mining is rapidly becoming a science instead of a rule-of-thumb operation. The cost sheet is no longer considered by its monthly showing, as in former days, but by its relation to the general result during the whole term of the operation.

The coal (with the exception noted before) is all coked in the beehive type of coke oven, and the coke is drawn by hand, as machinery has so far failed to perform that operation either as satisfactorily or as cheaply as the human coke drawer. The coal is run directly from large bins, located near the mouth of the mines, into hopper-shaped cars known as larries, and these, in turn, are hauled



MINE AND YARD FOREMEN'S HOUSES, CONNELLSVILLE, PA.
Trotter Coke Works, H. C. Frick Coke Co.

to the coke ovens by locomotives or some form of rope haulage, and the coal is spouted out of the larries directly into the ovens. The levelling of the coal in the ovens (a very important operation) is performed by hand-work; in fact, there are very few mechanical appliances in use about the coke yards. The oven now being built is generally 12 feet-3 inches in diameter by 8 feet in height, inside measurement. The general form of the structure remains much the same as it was in the early days of the industry, the only marked difference being the increase in size and capacity.

16-FOOT CAPEL FAN, LEMONT WORKS.

GUIBAL FAN, ADELAIDE WORKS.

In closing, I cannot refrain from referring to the one man, who, of all others, has been the great factor in the building up of the Connellsville coke industry, which represents an investment of over $100,000,000 and furnishes direct employment to 20,000 men. I have written of Mr. Mordecai Cochran as being the father of this industry, but Mr. H. C. Frick, of the H. C. Frick Coke Company, has been more—but for the physical incongruity of the term I would say that he was the mother, for it is he who has taken it into his arms an infant, as it were, giving employment to but a few hundred men, and nursed it year after year until it grew into the giant of to-day, employing over 20,000 workers—workers who are a credit to any land, for the workers of the Connellsville coke region are not by any means the degraded class of people that misinformed persons sometimes intimate they are. As a rule, a more orderly, industrious, and peaceable lot of men cannot be found in any industry. It is true there have been strikes and riots, but these never originated among the great majority; neither were they countenanced by them, but came from a few would-be dictators that no longer have a semblance of influence in the district.

The greatest concern of the region is the H. C. Frick Coke Company, founded and brought to its present unrivalled position by Mr. H. C. Frick and his lieutenant, Mr. Thomas Lynch. This firm at the present time owns 37,000 acres of coal; 12,000 coke ovens; 1,380 horses and mules; 17 drift mines; 22 slope mines; 12 shaft mines; 255 steam boilers; 35 steam locomotives; 150 stationary engines; 62 miles of coke-yard track or sidings; 350 miles of mine track; 6,243 mine cars; 21 air compressors, and employs 11,875 men.

All this has arisen in less than a business man's lifetime, and is a more eloquent testimonial than words to the ability of the men that brought up the industry from an infant in swaddling clothes to its present gigantic proportions.

ELECTRIC-POWER DISTRIBUTION IN GREAT BRITAIN.

By W. H. Booth.

THE late struggle for power to distribute electrical energy in Durham, Lancashire and South Wales that has recently taken place before the committee of which Sir James Kitson was chairman, and subsequently before the Lords committee, again draws attention to the huge claims of the municipalities to intermeddle in anything and everything, irrespective of whether undertakings proposed to be carried out can or cannot be performed by such authorities themselves. It is difficult exactly to define the attitude affected by municipalities. In some cases their position appears to be simply that of a strong company able and willing to provide the common necessaries of life, such as water, gas, or electricity, and perfectly competent to provide such at a price at which an outside profit-working company might find it difficult to compete. In other cases the opposition to the outside company arises purely from that peculiar conceit of the members of the local governing body that causes them to feel hurt in their dignity unless they can themselves control their little kingdoms in all things. This is apt to be the attitude of the smaller boroughs, and in many cases it arises from the occupancy of the mayoral chair by some strong man who carries with him the whole of the council or a majority of it, and, having been more than usually successful as a purveyor of soaps, sugars, and jam, thinks himself perfectly competent to undertake such affairs as electrical distribution. Were rate payers able to see behind the scenes they might sometimes be astonished to find how small was the real return from some of their boasted undertakings. There is obviously no *prima facie* reason why a municipal enterprise should not be constructed and worked with the same commercial success as an undertaking by a public company, and in some of the larger municipalities this may be the case; but in others, and in many small towns especially, the intermeddling of the mayor, aldermen, and councillors is fatal to the best success. It has been known that the service of a tramway has been changed by some local alderman in the middle of the town without reference to the tramway officials, whose arrangements on other parts of the system went on as usual until matters came to the natural

stoppage resulting from such dislocation of traffic. One result of so-called municipal enterprise combined with short-sighted parliamentary action is seen in the astonishingly backward condition of Great Britain in respect of electrical undertakings, especially of tramways and power distribution. No country is so well adapted for both these as is Great Britain. The tendency of the cities, in common with most European cities, has been to concentrate themselves upon a small area. The introduction of railways did something to carry population into suburban districts. But railways soon found their limitation. They were costly to construct, and few towns had more than a couple of radiating lines, while the presence of the next station at a distance of several miles is evidence that the dispersal of congested population formed no part of the policy of the railways, while the persistent survival of the ommibus is proof that they did not succeed even where they attempted it. This failure of the steam railways arises from the fact that their expensive construction compelled them to confine themselves to narrow lines, whereas the ideal of the electric tramway is to occupy each one of the public roads leading out of a town, in order to distribute population over an extensive area rather than upon a narrow strip of land along one or two routes only. The object has been to take people further afield and to remove them from the unhealthy crowding of the city into more open country. The advantages of doing so have, it is true, been very largely eliminated or even entirely negatived by the greed and rapacity of the speculative builder and the ease with which he has been able to build up unsanitary houses in the open country upon insufficient areas, unprovided with sufficient garden space, and without drainage, water supply, light, or any measures of sanitation or comfort. The narrow minds of the average local authority or officialdom have of course been opposed to the policy of dispersion of population, for they have viewed this as so much depletion of the rateable population. They would prefer to huddle their teeming millions into narrow courts and alleys rather than allow them to move further afield. In cases where such migration has taken place the boroughs have frequently sought powers to extend their areas. A notable example of this is Manchester, which at one time became retrograde through spread of population, coupled with trade stagnation preceding the construction of the ship canal. Manchester absorbed the new growths by extending her boundaries.

It is very clear that suburban traffic is one of the chief sources of income of the electric tramway—often, along certain routes, the only source. The experience of America points to the removal of con-

siderable masses of people from the towns. The narrow view that this necessarily implies reduction of taxable property cannot be allowed, even if true, to interfere with such movement. Obviously it cannot be true in any place so thriving as to encourage the promotors of a tramway to spend their capital therein, for the destruction of inferior houses can only mean the erection of better and more business premises to supply the needs of the growing suburban population. To the ordinary man of sense it would appear to be the duty of every municipality to expend its labour and energy in extending its borders so as to embrace what it considers to be its own population, and to provide for such population the sanitation and drainage necessary to their well-being—sanitation, drainage, and water supply being the fittest objects to occupy municipal enterprises and the least suitable for private enterpjrise. No one is injured when a family elects to sit in darkness because the head has fallen out with the gas or light-supply company. But the public suffer *en masse* when a water company fails in its supply or exercises its power of cutting off a supply in order to pay a bigger dividend or avoid expenditure. It has been particularly unfortunate for Great Britain that the selfish policy of the municipalities should have embraced electrical enterprise, because, if there is one thing more than another that is unsuitable for municipal control it is the generation and distribution of electrical energy, more particularly in the form of power. Fifty years ago the influence of the so-called agricultural interest was largely responsible for the legislation that killed the then hopeful automobile industry. The steam carriages of Gurney and Hancock had even then arrived at such a position of excellence as the vehicles of to-day can hardly be said to have yet reached, if due consideration is accorded to the differences of mechanical construction available now and then. This automobile legislation is responsible for the continuauce of the congesting of population, which would otherwise have been checked by means of regular lines of automobile vehicles on all the roads out of the towns. The problem has remained to be solved by the electric tramway. The narrowest municipal view of electrical tramways would, if carried out, confine all such enterprises within the limits of the municipal area, and no system could be other than coterminous with the municipal boundary, while traffic would be confined purely to very narrow circles. The experience of America has shown that it is to suburban traffic that tramways must look for success, while such limited experience as has yet been gained in Great Britain not only supports the experience of America, but even shows that a very con-

siderable interurban traffic may be expected, and that this is nowhere more marked than along lines of communication already supposed to be served by steam railways. The amount of traffic to be picked up by any system of tramway or railway appears to vary with some power of the number of service units per hour. Unless, therefore, a tramway extend considerably beyond municipal limits it is very unlikely to pay. Yet the narrower municipal idea would sever the portion of line within a borough from that outside and utterly preclude any reasonable system of working. In the more liberal municipal mind the aspect is more extended, and while the ownership of the tramway within the municipal boundary is claimed for the municipality, the working of the line is leased by agreement to an independent company, while the provision of power may be the province of either party. Judging by the present attitude of the municipal authorities, it does not appear hopeless to expect that such joint agreements may be both frequent and satisfactory, nor does it appear outside reason that a town should have the control of the lines within its area, though it is obviously out of reason that any town should, through its officials, absolutely oppose the construction of tramways when such are a necessity for the well-being of the inhabitants. When, however, the general question of power distribution is considered, the case is altered. It is plain to the ordinary mind that Great Britain is not on a par with many other countries in this respect, and that the question of cheap power is one of great importance Power cannot be manufactured and distributed with economy by a number of independent interests. The fundamental idea of power distribution is that the generation shall take place at some site where the ultimate sources of the power can be procured at a minimum of cost. In Great Britain, as a rule, this condition will be filled by locating the power house on a coal field. As the subject is one of national importance, it is clear that no narrow local interests should be permitted to intervene. Fully to carry out a system of power distribution demands that not only should the smaller towns and villages be supplied, but that the centres of population, the large towns, should be upon the same system. We may suppose two towns ten miles apart, A and B, with several small villages between. A is supplied by the distribution company. It will not pay to carry current to the ten miles of country beyond A, but it would pay to carry it to B, when the intervening area could payably be supplied from the mains. But B refuses to take current, thus practically depriving the country between of the advantages that would otherwise accrue to it.

In the case of the recent power bills it was obvious that the opposition had no grasp of the national importance of the interest involved. With the strong foreign competition that has now to be faced, each self-centred borough presented its little parallel to the fiddling of Nero. The declaration of the committee as to the additional claims to be embodied in the various bills was as follows:

1. The company to be authorised to supply electric energy for power purposes anywhere within the area of supply, subject to the consent of the local authority in certain cases as set out below.

2. The company to have no general lighting powers (*id est,* distribution to ordinary consumers) within the area, except in pursuance of a provisional order obtained in the ordinary way.

3. Where a local authority is now authorised to supply electricity within the area, then consent is to be required to the supply of electricity by the company. The Board of Trade to be empowered to override the refusal of the local authority to give consent, if the authorities are not prepared to provide the requisite supply on reasonable terms and within a reasonable time.

4. Any local authority who hereafter gets statutory powers for supplying electricity within the area, to have in ordinary cases the option of taking over the company's supply in its local area, on terms to be laid down by the provisional order or act by which the statutory powers are given.

5. A company having statutory powers to be in the same position as a local authority now having statutory powers, a company to whom powers are hereafter granted to be placed in the same position as a local authority to whom statutory powers are hereafter granted.

From the above it is seen that the power-distribution company is by (2) forbidden to supply current for lighting purposes unless by special powers. By (3) the company must not supply any current in any area supplied by a local authority, unless such authority consents. All experience tells that such consent will rarely be obtained unless compelled by the Board of Trade, and a long vista of local inquiries is opened up, for the authority is only called on to provide the *requisite supply* at a *reasonable price* and within a *reasonable time.* By (4) the local authority is to have power to take over the supply whenever it obtains power to supply current itself within its own area. Very extraordinary is (5), for this proposes to compel the supply company to sell its undertakings to some other company should such be formed. The whole cannot be termed satisfactory, nor evidence of the wisdom of the committee. With a broad scheme

before them, they have practically given way to the clamour of the municipal faddists and have placed one more obstruction in the path of British industry. Clause (3) will, it is to be feared, prove an unending source of trouble. The negotiation for the supply of any and every customer within such an area as falls within the scope of this clause will be subject to the arbitrary refusal of the local authority to allow such supply. Then will follow the appeal to the Board of Trade, if the would-be consumer has not already been frightened off his agreement by the worry and arrogance of the check already received. Assuming the question to have reached the Board of Trade, much depends upon the attitude of the Board and its interpretation of the term *reasonable*. It is unlikely that a local authority will be able to supply electricity as cheaply as a large power-distribution company. There is nothing to show that the Board of Trade may not allow, as a reasonable price to be charged by the local authority, such a figure as will render it impossible for the proposed customer to accept. To gain some idea of the kind of custom likely to be secured by a power company, a correct example may be taken, such as would fit hundreds of power users under the Lancashire scheme. A standard cotton factory requires an indicated power of 1,000 horse. A liberal fuel allowance is 2 pounds of coal per horse-power hour, and many mills run for less, but the still higher figure of 2.24 pounds will be assumed, for this represents just one ton of coal per hour. At 12 shillings per ton, with an allowance of 1 shilling per hour for the engineer and 1 shilling for fireman, and 1 shilling for oil and stores, the total is 15 shillings per hour. Interest and depreciation on the boilers, economisers and chimneys may add another 3 shillings, bringing up the total cost to 18 shillings per hour, the assumption being made that the electrical plant will cost as much as the engines and buildings displaced. The cost of electrical driving will be as follows: About 750 horse power will be called for, with motors placed on each line shaft, or let us even say only 500 units, so as to place electrical driving in a favourable light. The hours per annum will be 2,800, and the annual consumption barely 1½ million units. To compete with steam, the price would then require to be less than one half-penny per unit, a figure which may usefully be compared with the price per unit supposed to be reasonable when granted by the Board of Trade to municipal stations as their right when supplying current for tramways, a figure which is apt to average more than three times the modest half-penny. Such large consumers as a 1,000 horse-power factory would however in no case be likely to come in as customers even when newly established, while if

they were already going concerns they would not soon be persuaded to discard the steam plant for an outside source of power. The other extreme is the small workshop, using very little power, and paying heavily for it—the little shop with small and wasteful engine and boiler, expensive attendance, and costly breakdowns and delays. The power in such a shop may run to the high figure of 5 shillings per horse-power hour, and a charge of even 6 pence per unit is to such a place a trifle. Between these limits there is a large field, not merely of small customers, but of that class of large customers with extensive works of a widely scattered character, the cost of power for which more or less approximates to the figure of the small works. Incidentally it may be remarked that the system of heavy charges for small users of current is not sound, because in the multitude of small users there is the potentiality of a steady load factor. If there is one thing that has particularly characterised the electric-light companies of this country it is the efforts made by them not to allow current to cease in their mains. Every effort is made to preserve supply, often under most discouraging and arduous conditions. The supply of power to a manufacturing customer is a duty that is fraught with far worse consequences in case of failure than usually ensue from the failure of light. The latter can be remedied by the use of other illuminants, but the failure of power is something against which there can be no remedy so reasonable in cost as to be allowed to enter into the question excepting in cases out of the ordinary. Indeed, the storage battery is practically the only remedy or safeguard, and it is one that will not be adopted unless with the inducement of a considerable abatement in the price per unit of current. It is tolerably certain that the supply of current by a local authority would not be received so favourably by consumers as the supply by a trading company that was dependent for a continuance of its trade upon the certainty and regularity with which it performed its duty, and against whom the consumer would not be without a remedy in the same sense that he would be in event of failure to supply on the part of the local authority. It is well known that municipal officials will expend money on legal proceedings to defend indefensible cases, simply because such money is not their own, while they may even secure a holiday trip to London as well-paid witnesses, and all experience points to the prospect that failures to supply will be greater and more numerous on the part of a local authority than by a trading company, and that remedy for default will be far more difficult to exact. Such a condition can have but one effect. When a consumer is bound to buy current from the local authority, or not at all, he will

probably elect to go without, and will adhere to his old and wasteful methods. The very end and aim of a national movement of economy will thus be frustrated to pander to the craze for municipal trading. The worst evil of municipal trading of this type is that it is not trading. The best markets are not secured, because it is considered policy to purchase in other directions. The best talent is not secured, because good men do not get along with a multitude of masters, and the best labour is not available, because there is too much consideration of votes and influence, and it has not been unknown for the officer of a local plant to be under the orders of a committee containing his own subordinates or insubordinates. All these and similar well-recognised difficulties of municipal undertakings will render the municipal distribution of power more costly than it would be in the hands of a large company generating power in a favourable locality. Few municipalities could distribute power economically without going beyond their own borders with mains and power stations. The tendency of the committee's clauses will be to deprive the areas claimed by local authorities of all the benefits of power distribution, and to curtail the power of the supply companies to distribute as cheaply as would be possible were the eyes of their districts not picked out. The sparser populated outside areas cannot be supplied alone, without the support of the better and more crowded boroughs. Such a prospect is not an alluring one. Again have the interests of the nation been frittered away by parliament as with the tramways act of 1870, again with the initial legislation of electric light, and now again with the power bills a deliberate stop is put upon industry. The investment of capital is hindered, and the one thing necessary to enable English manufacturers of electric plants to acquire experience and secure business that would enable them to compete abroad on similar lines, has been taken from them. For a long time the press has been full of complaints of the intensity of foreign competition. American locomotives, for example, to refer to a subject familiar to the chairman of the power bills committee, are running in Russia, Japan, Australia, New Zealand and South America, because certain English locomotive makers have gone more or less to sleep. Switzerland, a country where not a pound of coal is raised, has become a considerable manufacturing country, very largely because of the stimulus given to her industries by cheap power, for the natural water power of the country has been transmitted, and electrically transmitted, at what may be termed remunerative voltages. Compared with this energy, the sacrifice by the power bills committee of Ireland's interest to the hypothetical interests

of a few eels savours of the fatuous. It is indeed incomprehensible that Ireland's only source of power should be denied to the country, and small wonder that there should be a home-rule agitation to escape from the choking folds of such parliamentarians as now appear to control our destinies. It is certain that the prosperity of any country is so closely bound up with the possession of cheap power that the country will win in the race that first grapples with the problem of power provision in some communal form. A glance at the power consumers to-day shows the water-supply station busy pumping all day with a small night load, the electric-light station busy at night with no day load, blast furnaces throwing away millions of horse power all the year, tramways absorbing power twenty hours a day from coal burned in boiler furnaces. Were it possible to supply only the foregoing from a common fund the economy of fuel would be enormous. The advent of electrical transmission renders possible such an economy, as pointed out above, and a parliamentry committee says no. This economy will interfere with the desire of a few municipalities to supply power themselves by means of coal carried from a distance and burned under little knots of scattered boilers at extravagant rates and turned into power by wasteful little engines. It cannot be other than a subject for regret that such narrow and parochial legislation should obscure the prospects of futurity. The conclusion inevitably to be drawn cannot be other than that the members of the committee had no breadth of vision themselves.

The recent decision of the House of Lords committee that the Rushdale Corporation Tramways shall pay no profit, but expend all profits in reducing fares, is no doubt intended as a check on municipal trading. It opens a door, however, for an abuse that has been all too common in municipal affairs, for it will tend towards the payment of excessive prices for stores and other materials to favoured persons or firms, in which a suspicion of interest attaches to the officials and members of the various authorities. The almost inevitable result will be such carelessness in management as will probably result in actual deficiency. There will be very little difficulty in making no profit. Thus, no matter from what direction the question of municipal trading is looked at, very serious difficulties present themselves, nor has the management of undertakings that are essentially the duty of the municipality ever been marked by such ability as to warrant their interference in so national and vital a question as the distribution of power, wrapped up as it is with the better conservation of the one important service of national wealth, the coal supply.

THE USE OF WATER POWERS BY DIRECT AIR COMPRESSION.

By William O. Webber.

PROBABLY one of the oldest applications of the use of water power to the wants of man was a form of hydraulic air compressor which operated as an entrainment apparatus, and is the well-known water bellows or trompe of the Catalan forges.

This apparatus, briefly described, consisted of a bamboo pole disposed at a slight inclination from the perpendicular, into the upper end of which a stream of water was led, entraining air with it in its downward passage. The lower end of this bamboo pole was introduced into a bag made of the skin of some animal, the air being allowed to escape from the water into the upper part of the bag, from whence it was led by pipes or tuyeres to the forge, the water being allowed to escape from the lower edge of the bag. From this original device a great many improvements have been worked out, and besides this a number of other forms of hydraulic air compressors, or of compressors using other liquids for compressing air or other gases, have been designed.

A very simple form is a displacement apparatus,* consisting of a water reservoir and two air chambers of about three times the capacity of the water chamber. Water is led into the reservoir, compressing the air contained in it into the two chambers and giving a pressure of about 1.6 atmospheres.

Siemens invented an apparatus on the principle of the steam injector, but the use of this was confined principally to the production of a vacuum; it is used to operate the pneumatic dispatch tubes in London. It has also been used for blast purposes in Siemens' furnaces and in sugar works.

Another quite ingenious device, shown in a patent granted to W. L. Howe, consists of two flat plates enclosing an air space from which a pipe leads to the atmosphere. The upper plate is perforated with conical holes, the smaller end being adjacent to the air-space between

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The movement toward fuller utilisation of the yet unrealised water resources of the world is one which is constantly quickening. With greater use comes larger study of adaptation of machinery and methods of water-power development and transmission. The peculiar means described by Mr. Webber has more than a passing interest.—THE EDITORS.

* Appleton's Cyclopedia of Applied Mechanics, fig. 138, page 37.

the two plates. Directly opposite the apertures of the upper plate are corresponding conical apertures in the lower plate, with the smaller end of the aperture next the air space, the lower and larger part of the conical openings being prolonged by tubes; the upper plate is kept under a head of water; the water jet, passing across the thin air-space referred to, draws in the air through the large air pipe and compresses it through the smaller orifices.

Another device using a somewhat similar principle was invented by M. Romilly* and consists of a conical tube attached to an air reservoir by its larger end, and having a check valve interposed in the passage so as to prevent the air from escaping. Water is then injected into the smaller end of this conical tube through an ajutage in the form of a liquid vein at a given pressure, which entrains the air with it and causes it to be compressed in the reservoir. But the apparatus just described did not really employ the same methods as those used in the old trompe. One of the first inventions carrying out this idea was made by Mr. Frizell, of Boston, Mass. His invention made use of an inverted syphon having quite a little horizontal run between the two legs. A stream of water was led into the upper end of the longer leg, and at the top of the horizontal run between the two legs of the syphon was provided an enlarged chamber in which the air would separate from the water, the water being then led off from the lower part of this air chamber and passed off through the short leg of the syphon, the pressure of the air accumulated in the air chamber being therefore due to the height of water maintained in the shorter leg of the syphon. This application of carrying upward the water, after the air was separated from it, so as to produce a considerable pressure upon the air, seems to have been original with Mr. Frizell, and in this feature his device differs from the old trompe.

Mr. Frizell made two working models of this type of apparatus. In the first one the legs of the syphon were 3 inches in diameter, the head of water being 25 inches, and an efficiency of 26½ per cent, was obtained. A larger apparatus was then constructed at the Falls of St. Anthony, on the Mississippi River, a few miles above St. Paul; the longer leg of the syphon in this plant was 15 inches by 30 inches and the short leg of the syphon 24 inches by 48 inches in section; the height of water above the air chamber was 29 feet. The head in feet varied from .98 to 5.2, the first head being just sufficient to cause a flow through the pipes. The working head varied from 2.54 feet to 5.02 feet and the efficiency from 40.4 per cent. to 50.7 per cent., the quantity

* Appleton's Cyclopedia of Applied Mechanics, fig. 139, page 37.

of water in these cases varying from 5.92 to 11.89 cubic feet per second.

Mr. Frizell estimates from the experiments he has made that with a shaft 10 feet in diameter, a depth of 120 feet, and a fall of 15 feet, the efficiency would be 76 per cent., and with a head of 30 feet and a fall of 230 feet the efficiency would be 81 per cent.

Another device, differing somewhat from that of Mr. Frizell, was invented by A. Balochi and A. Krahnass in 1885, and consisted of a syphon carrying water from an upper reservoir down to another reservoir situated at a lower level, the lower end of the syphon being projected through an inverted vessel placed nearly at the bottom of the second reservoir. Just beyond the bend of the syphon, and in line with the vertical axis of the longer leg thereof, was an air pipe projecting into the descending column of water, thus entraining the air with the descending column, and carrying it down into the inverted chamber, where the air escaped from the top and the water passed out from the bottom of the inverted vessel into the lower chamber. This also produced pressure on the air in the top of the inverted chamber, due to the height of the water column upon it.

Another device, patented by Arthur in 1888, differs from the last in having a stream of water led directly into the top of the vertical pipe. Inserted into the mouth of this pipe was a double cylindrical cone, making an annular air passage surrounding the mouth into which the water was delivered. The water, after passing through the upper cone and there being compressed and its velocity increased, then passed into the inverted cone, where the velocity was somewhat decreased and the water became more diffused. This lower cone was perforated with holes opening into the annular air chamber previously described, causing air to be entrained with the falling water. Inside of this down-flow pipe was a vertical delivery pipe for the compressed air, having its lower end enlarged and open at the bottom. Projecting upward into this enlarged air-delivery pipe was a

THE MAGOG DAM AT HIGH WATER.

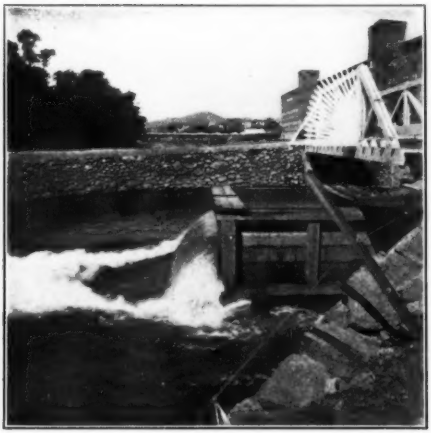
water-escape pipe through which the water passed after having parted with the air. This escape pipe was in the form of an inverted syphon and maintained a pressure on the air in the delivery pipe, due to the elevation of the water at its discharge point above the air line in the large end of the delivery pipe.

THE WEIR BOX AT MAGOG, FROM THE BRIDGE.
Observers taking readings from the hook gauges.

A number of other patents on apparatus of this type were issued to Charles H. Taylor, Nos. 543,410; 543,411; 543,412, July 23, 1895; his invention consisted principally of a down-flow passage having an enlarged chamber at the bottom and an enlarged tank at the top. A series of small air pipes were projected into the mouth of the water inlet from the large chamber at the upper end of the vertically descending passage, so as to cause a number of small jets of air to be entrained by the water, Taylor seemingly having been the first one to introduce the plan of dividing the air-inlets into a multiplicity of smaller apertures evenly distributed over the area of the water inlet.

Taylor at first seems to have attempted to utilize centrifugal action in causing the separation of the air and water in the large chamber at the bottom of the compressed column, but afterward abandoned this scheme and used, instead, forms of deflector plates in combination with a gradually-enlarging section of the lower end of the down-flow column in order to decrease the velocity of the air and water and cause partial separation to take place, and also using the deflector plates to cause the water to change its direction of flow, evidently with the idea that the air would escape more readily.

The latter improvements on this device have been in the method of introducing the air into the mouth of the downwardly-flowing water column, so as to insure the largest proportion of air being taken down with the water, and in methods of decreasing the velocity of the combined air and water at the bottom of the descending column, causing



THE WEIR, SHOWING FORM OF WAVE CREST.

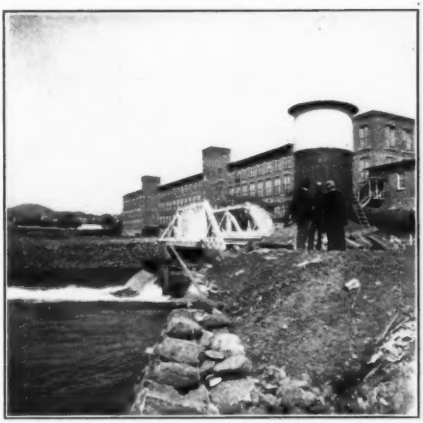
the water to part more readily with the air, the water then passing out at the bottom of the enlarged chamber into an ascending shaft, maintaining upon the air a pressure due to the height of water in the uptake, the air being led off from the top of the enlarged chamber by means of a pipe.

The first one of these compressors on the Taylor principle was installed at Magog, Quebec, to furnish power for the print works of the Dominion Cotton Mills Company. The head of water is 22 feet; the down-flow pipe is 44 inches in diameter, and extends downward through a vertical shaft 10 feet in section and 128 feet deep. At the bottom of the shaft the compressor pipe enters a large tank 17 feet in diameter and 10 feet high, which is known as the air chamber and separator.

A series of very careful tests on this plant demonstrated that out of a gross water horse power of 158.1, 111.7 horse power of effective work in compressing air has been accomplished, giving therefore an efficiency of 71 per cent. It is found that the air after compression shows a very considerable decrease in moisture from that of the air entering the compressor, although in contact with the water

COMPRESSOR HEAD TANK AND WEIR.
The air compressor is blowing off.

all the time. This is probably due to the moisture in the bubble of air being pressed or squeezed out to its surface and then absorbed by the surrounding water. The air is compressed at the temperature of the surrounding water and the compression is isothermal. Owing to these facts there is no loss by heat of compression and again by radiation, in using the air, and there is a practical result which is of more importance: the hydraulically-compressed air can be expanded down to a temperature much below the freezing point, while atmospheric air with its usual amount of moisture, mechanically compressed, cannot be used at all, owing to the freezing up of the exhaust passages of the motor in which the attempt to use it is being made.



THE MAGOG MILL AND WEIR.

All the water passing over the weir has passed down through the air compressor.

VIEW TAKEN BY POINTING THE CAMERA DIRECTLY DOWNWARD OVER THE EDGE OF THE WEIR.

The clouds are made by the finely-divided particles of air carried in suspension. In the limpid Magog water these may be traced 40 or 50 feet below the weir.

The accompanying photographs give an idea of the extent of the plant and of the volume of water used. The last one, showing the air carried in suspension, is especially interesting. The air cloud may be traced in the water quite as distinctly as it is shown in the photograph, for 40 or 50 feet below the weir.

THE CENTRALISATION OF THE STEAM-CONDENSING PLANT.

By Harry G. V. Oldham.

URING the last ten years the problem of the economical condensation of steam has attracted considerable attention in Great Britain and America, and also on the Continent. An impetus has been given to the manufacture of condensing plants by the demand from the large number of electric-light and power stations that have sprung up all over the country. The conditions that prevailed previous to the time of this demand do not now obtain; in fact, except in marine practice, steam users were content to allow the steam to exhaust into the atmosphere, and even now there are large units so dealing with their useful work.

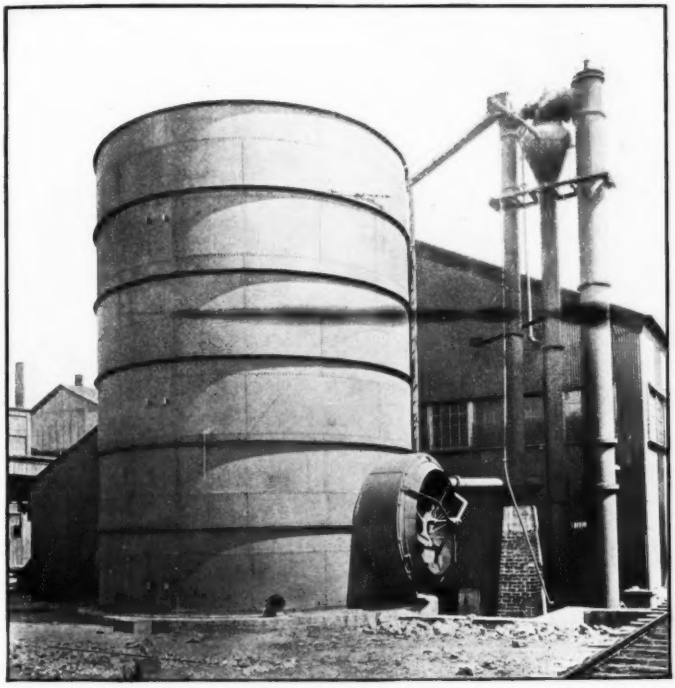
One of the principal reasons of this waste of power is an insufficient supply of water, and even where a constant supply of water is available, if from a town main, the cost would prohibit it being used for condensing purposes, if there were no method of using it over again. It is now possible, by the use of a cooling tower or evaporative condenser, to reduce the quantity of water required for condensation purposes to less than that of the boiler feed—*i. e.*, a steam plant can use less water when condensing than when non-condensing. The saving in the coal bill due to the reduction of the back pressure on the piston is so well known that it need not be enlarged upon here. This reduction of back pressure is due entirely to the efficiency of the condensing plant and its arrangement, and to the use of a carefully-designed air pump and connections.

One objection made to fixing a condenser at any great distance from the engine is that trouble is experienced with the increased number of joints. In several cases, however, it does not seem to have been

The whole story of the vast growth of steam-using is written under the one text—constantly-bettered economy. Higher efficiency has made possible larger applications, greater installations, higher speeds, longer runs. We have long learned the advantage of centralising the steam-generating plant—the *positive* reservoir of the steam-power plant; it is rather to be wondered at that the study of the economy of centralising the *negative* reservoir—the condensing apparatus—has been so long deferred.

Newcomen used the engine cylinder itself as the condenser; Watt made the first great step in improvement by introducing the separate condenser; another great stage in the evolution of steam economy on the farther side of the engine is marked by the movement toward centralised condensing plant. Mr. Oldham's comprehensive study of the subject has therefore a great as well as a comparatively new interest.—THE EDITORS.

the intention of the maker to bestow very much care on the design and erection of the exhaust main, some joints being made with the flanges not even machined; when the pipe has been made of steel plates, moreover, the rivets have been so far apart as to make it im-



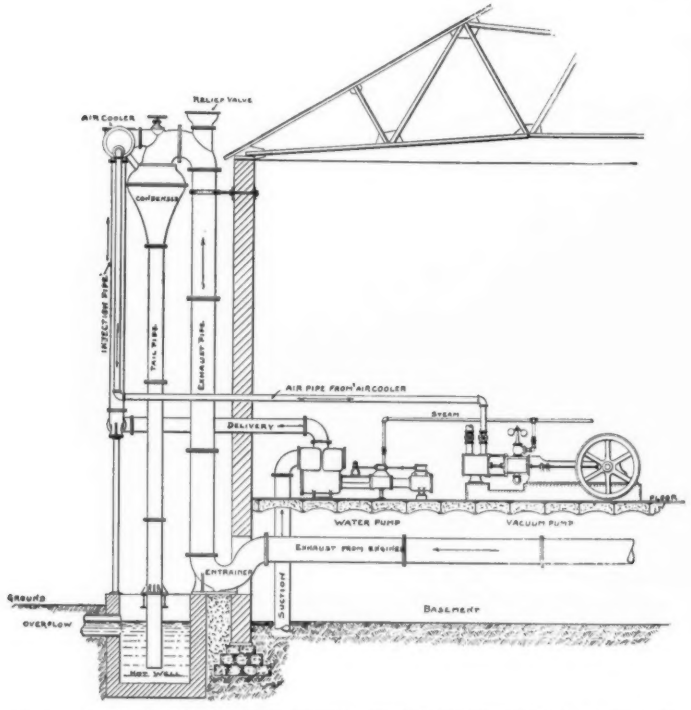
CENTRAL CONDENSER WITH COOLING TOWER, ST. LOUIS STAMPING COMPANY'S WORKS, GRANITE CITY, ILL.

The plant maintains a vacuum of 24 inches upon four tandem-compound Corliss engines for driving plate rolls, no water-supply for condensing purposes being available.
Henry R. Worthington, N. Y.

possible to caulk the edges properly without buckling, and the flanges have been so thin as to put a tight joint out of the question. For this reason condensers that can be placed near the engine are sometimes preferred. But exhaust pipes can be and have been made that, in a distance of hundreds of feet, admit of a drop of only fractions of an inch in the mercury gauge. Of course considerable care is taken in the design and manufacture of such pipes, and, moreover, they are tested under a severe water test, both at the works and after erection.

The same thought and care should be bestowed on this important

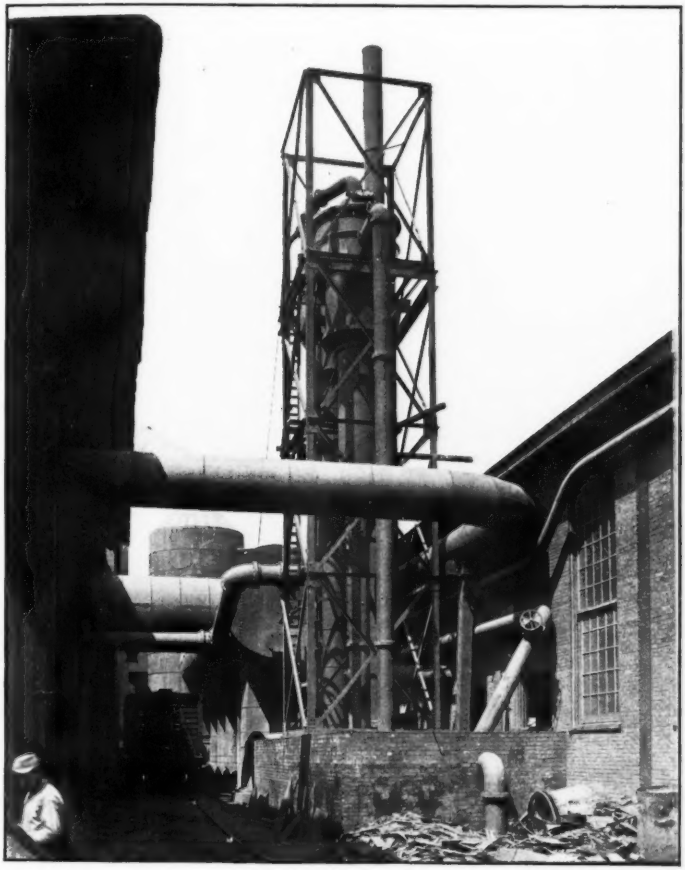
run as are expended on steam pipes—perhaps even more. Therefore, if this is borne strictly in mind, there is no reason whatever why a condenser should not be placed at a considerable distance from the main engines. There is no need to do this, however, when stations are being newly constructed, as a place can be provided within a reasonable distance of the main engines. It is not necessary then to split the condensing apparatus up into small units and attach one to each engine. The condensing apparatus can be set apart by itself and its capacity



OUTLINE VIEW OF WORTHINGTON CENTRAL JET CONDENSER, SHOWING WATER AND VACUUM PUMPS, AND RELATIVE POSITIONS OF THE SEVERAL PARTS.

be made such as will deal with the whole of the steam given out from the boilers. This presents no disadvantage, no more than does the whole engine installation, which depends on a single battery of boilers coupled up to one steam main.

The condensing plant should be looked upon as a separate institu-



ONE OF NINETEEN WEISS CONDENSERS INSTALLED BY THE CARNEGIE STEEL CO.

Condensers of this type are built capable of handling 300,000 lbs. of exhaust steam per hour. They will work with condensation water at 125 degrees to 400 degrees F. temperature. Southwark Foundry and Machine Co.

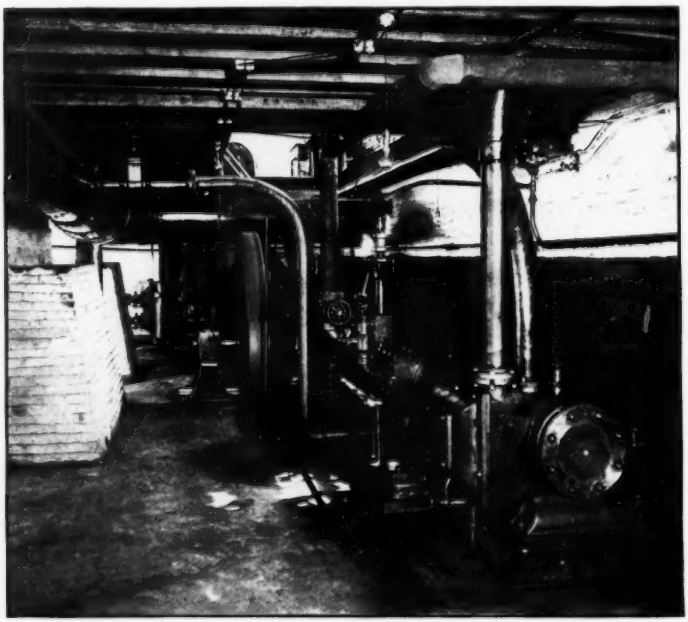
tion. In such case the air and circulating pump are put in operation and a vacuum pro luced immediately before the main engines are started; this is especially valuable when engines have to start under their full load.

In the case of steamships considerable saving may be effected by the use of a common condenser and independent air pumps. At present, as long as the main engines are running, the auxiliaries may dis-

charge their exhaust steam into the main condenser, but when the vessel is in port and the main engines are shut down, during the whole time of loading and unloading, the auxiliary plant has to exhaust to atmosphere if there are no independent air pumps. This auxiliary plant often includes powerful electric-lighting engines. It follows that there must be a considerable loss here due to increased coal consumption, besides the inability to use the condensed steam for boiler-feed purposes.

It is not proposed in this article to deal with installations where a large quantity of water is available for condensing purposes, but this case is mentioned inasmuch as it shows the advantage of an independent air pump and condenser.

In arranging a centralised condensing plant there are several important points to be taken into consideration, which for the most part are raised by the work required in the external service or the character of the load upon the engines. In the case of an electric-lighting station the load during the day is only small compared to that thrown upon the engines a few hours after sunset, whereas at stations generating



AUXILIARY MACHINERY FOR THE WEISS CONDENSERS SHOWN ON PAGE 59.

electricity for street cars the load is within certain limits constant, as also is the case with factory engines. In the latter case only a small subdivision of the condenser is rendered necessary, such as would allow one section to be eliminated for any slight repair, without in any way interfering with condensation of the steam. Such portion should constitute a reserve, as in the case of one (or perhaps two) elements in the boiler installation. It is not suggested the condenser should be one huge apparatus, such as one boiler to supply the whole of the steam for an extensive plant, but it is desired the arrangement of the condenser plant should be similar to that of a boiler plant—*i. e.*, its position should be central, a spare section should be provided for (although under exceptional circumstances the engine could exhaust to atmosphere), and the connections should provide for cutting out any particular element.

In dealing with an installation like that mentioned in the former case, where the maximum supply is required during a few hours of the day, the same principle holds: but provisions must be made for cutting out an entire element in conjunction with the engine it serves. It is advisable here (we are dealing with large units), to apportion a separate element of the condensing battery to each engine unit. The two may then be cut out and started simultaneously. This is not absolutely necessary except where separate air and circulation pumps are connected dealing only with this element. At full load all the junction valves would be open and the condenser would form one continuous apparatus. The evaporative condenser adapts itself very well to this purpose. In an arrangement of this type there is a stage at which the air and circulating pumps reach dimensions which it is not desirable to increase, and it is at this point where the sub-division should commence.

The most recent arrangement of surface condenser and cooling towers is the one in which a surface condenser, with its air and circulating pumps, is placed between two engines and receives the steam from both. Engines of 800 to 1200 indicated horse power are dealt with in this manner.*

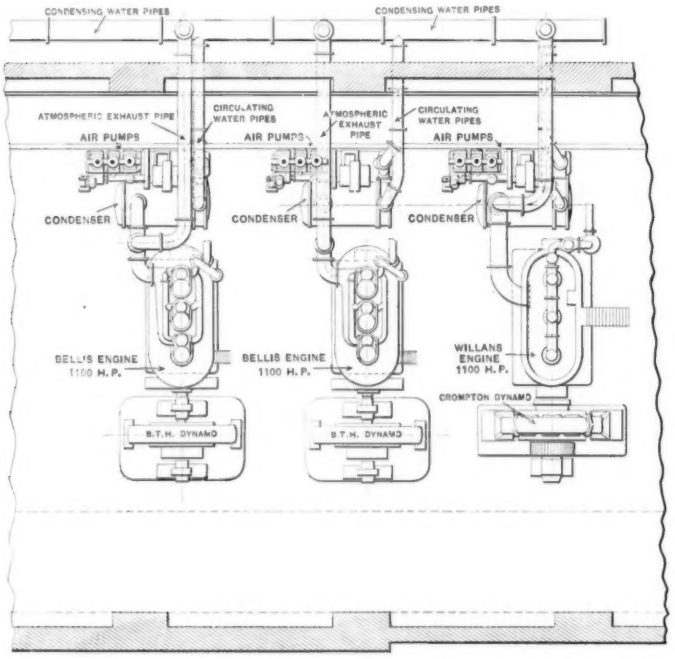
The condenser is sometimes placed below the floor level, to avoid taking up space on the engine-room floor. Where this arrangement of the condenser is adopted it is the cooling tower that is centralised, as the water from the whole of the condensers is delivered over a battery of towers. Each pair of engines may exhaust into the condenser,

* Throughout this article, 20 pounds of steam are assumed as the quantity necessary to develop one horse power.

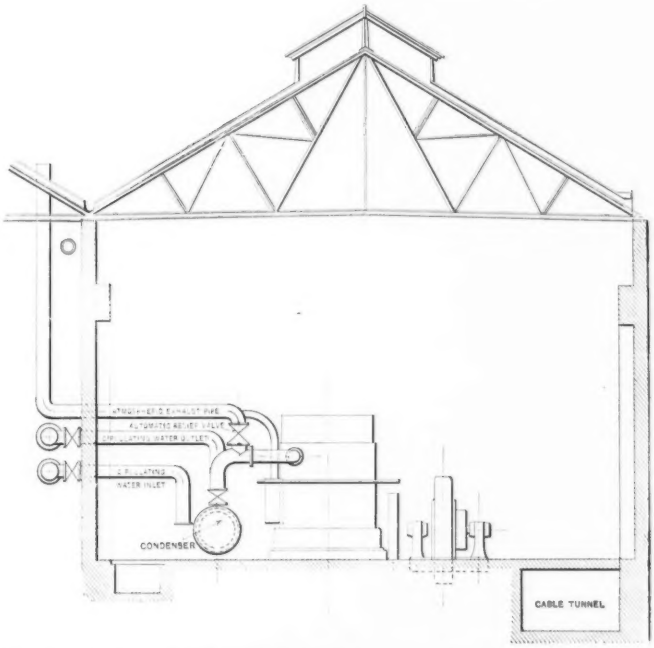
or only one may do so; in the latter case the speed of the air and circulating pumps is regulated to conform to the smaller quantity of steam.

Therefore, summarising briefly: the most economical system to adopt, when the engines are small and placed in different parts of the building and the load fairly constant, is a single condenser arranged in a central position (with its air and circulating pumps), taking the steam from all the engines through one exhaust main; when the engines are large and the load is uniform, the same arrangement may be adopted with complete success; lastly, when the load is variable and this variation is great and the maximum is only maintained for a few hours during the day, then each engine or pair of engines should have a separate condenser (but only in the case where the engines are of high power), thus enabling the entire unit to be cut out.

Such an installation is shown below, and has been adopted by Mr. W. A. Chamen at Glasgow. Each engine has its own con-



ARRANGEMENT OF ENGINES AND CONDENSERS, PORT DUNDAS ELECTRICITY STATION, GLASGOW. PLAN.



PORT DUNDAS ELECTRICITY STATION, GLASGOW. SECTION THROUGH ENGINE ROOM, SHOWING ARRANGEMENT OF CONDENSERS.

denser with independent electrically-driven air and circulating pumps. Each set of engines is of 1,100 horse power at economic load, and capable of working up to 1,500 horse power on emergency load. The pumps are the Edwards type, with three cranks, and each circulating pump will throw 108,000 gallons per hour. A Blake & Knowles automatic exhaust valve is fitted to each engine. A photograph of the air and circulating-pump set is shown later on page 67. Each condenser has 2,500 square feet of surface.

The circulating-water delivery pipes may be carried to the cooling tower, or, as in this case, to a canal.

It is advisable to get the condenser as near the engines as possible for obvious reasons, and this is followed out in the latest arrangement of surface-condensing plants with cooling tower; this arrangement works well provided there is available space in the engine rooms for the condensers. But in some cases, where the engine units are small, this has resulted in having a number of condensers scat-

tered all over the place, which is, as before mentioned, a very undesirable and uneconomical condition, with a heavy first cost.

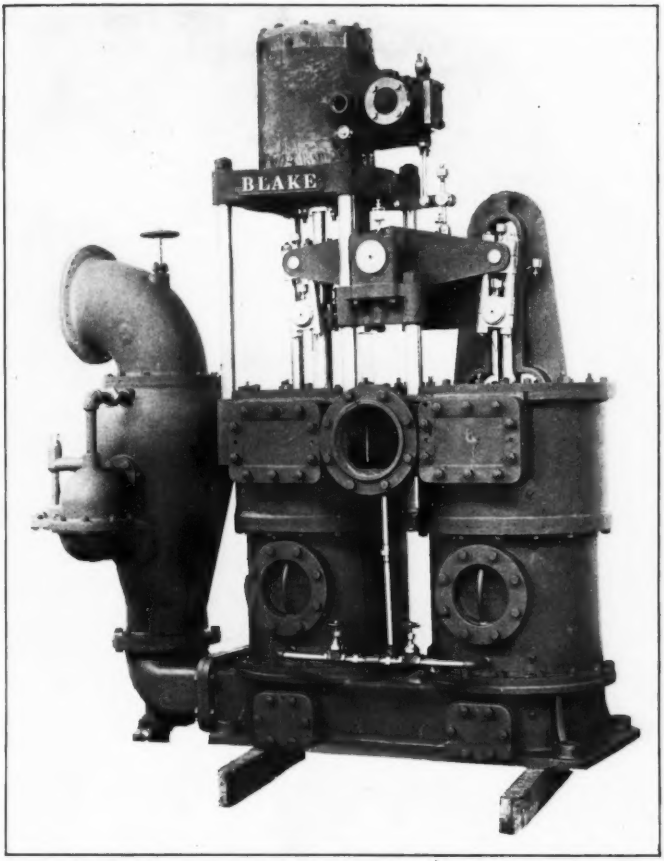
It would be interesting to mention here an installation at Messrs. Vickers Sons & Maxim works, Barrow-in-Furness. In this case all the engines are connected to a surface condenser capable of dealing with 20,000 pounds of steam per hour and equal (on a basis of 20 pounds steam per indicated horse power) to 1,000 horse power. There are probably thirty engines coupled up to this condenser, including the small shop engines.

After all the only conclusion that can be arrived at, whether the condensing plant be jet, surface, or evaporative, is to centralise it. It is the most economical arrangement. The exhaust pipe can be made just as sound, and very little trouble need be experienced with leaking joints.

Keep the condensing plant out of the engine room whenever possible. This brings forward a question in connection with the design of the station, and it is here that it is highly important that the disposition of the condensing plant should be considered—in fact, that it *must* be considered. Ground space in any work is in most cases limited, often very limited, but there is space available above the engine room and boiler house that can be made use of.

Provided ample light can be admitted at the sides of the building, the engine-room roof can be made flat; but should the position necessitate the roof being used for the admittance of light, then the boiler-house roof may be made flat, and it is generally the case that one of the two may be so treated. Make the boiler-house roof flat, properly built with girders and concrete; in some cases the cast-iron or steel tanks may form this roof. The best method, however, is to finish the roof in concrete, though this is more expensive. Upon this roof the condensing plant may be placed; the run of pipe from the engines is then very short, depending practically upon the height above the engine-room floor; a direct run can be taken almost free of bends from the engines to the condensers.

In an arrangement of this type the air pumps are in the engine room and the circulating pump on the roof, or, if possible, just below. The efficiency of evaporative condensers is increased by their being exposed. The surface condenser would be better under cover, nothing being gained by exposing this type to the atmosphere; but the cooling tower is in exactly the same case as the evaporative condenser, and should be free on all sides to the atmosphere. Cooling towers that have a fan circulating air through them need not be dealt

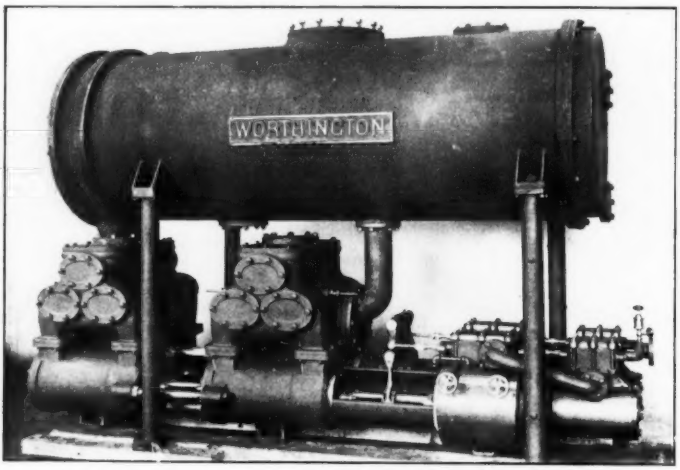


BLAKE SURFACE-CONDENSER SET OF AIR AND CIRCULATING PUMPS.

with in this manner, but the efficiency of the apparatus is increased if the atmosphere is all allowed free play all 'round it. The top, however, must always be open to the air, to allow the vapour to escape.

Surface Condensers.—The internal construction varies very little from the marine type; improvements have been made in securing a sound joint at the tube ends. In the Worthington condenser one end of the tube is flanged and held firmly by a screwed bush, while the other end passes through an adjustable gland which allows free expansion of the tube. Sometimes the Thornycroft expanding or split

ferrule is used; this has the advantage of keeping tight in the tube plate. W. H. Allen & Son countersink the ferrule and round the ends where the circulating water is delivered, so as to give the water an easy flow. They found by experiment that this reduced their pumping head by 3 feet. The external form is usually round or rectangular, with the air and circulating pumps or combination sets placed

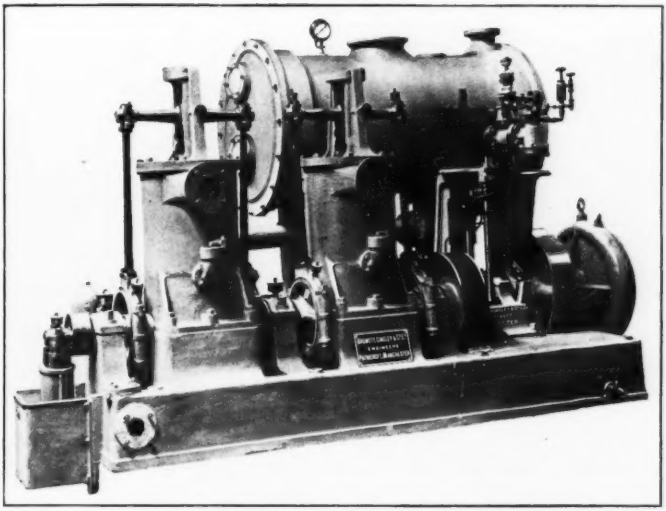


COMBINATION AIR AND CIRCULATING PUMP, WITH SURFACE CONDENSER.
6 and 10 by 12 inch. Worthington Pumping Engine Co.

below or behind. The cuts on pages 65, 66, 67 and 68 show types of these condensers manufactured respectively by The Blake & Knowles Steam-Pump Company, The Worthington Pumping-Engine Company, Messrs. Browett, Lindley & Co., and Messrs. W. H. Allen, Son & Co.

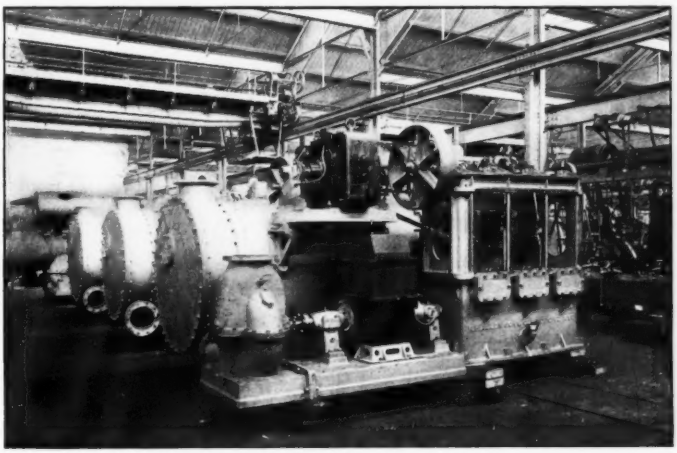
Condensers of this type are made in as small units as may be desired. Such condensers are compact and self-contained, and may be arranged to take the steam from all the engines, but they are particularly valuable as independent condensers coupled up to engines that for the most part of the day are not running.

Cooling Towers.—A surface or jet condenser cannot be installed, where water is scarce or expensive, unless a cooling tower be provided, and it is the introduction of such towers that has made it possible for a number of large plants to condense. The principle involved, of cooling water through towers or other medium, involves more than one process; as the water to be cooled passes over the



SURFACE CONDENSER WITH CIRCULATING PUMP.

10,000 lbs. steam per hour; three 150 horse-power engines. Browett, Lindley & Co., Ltd.

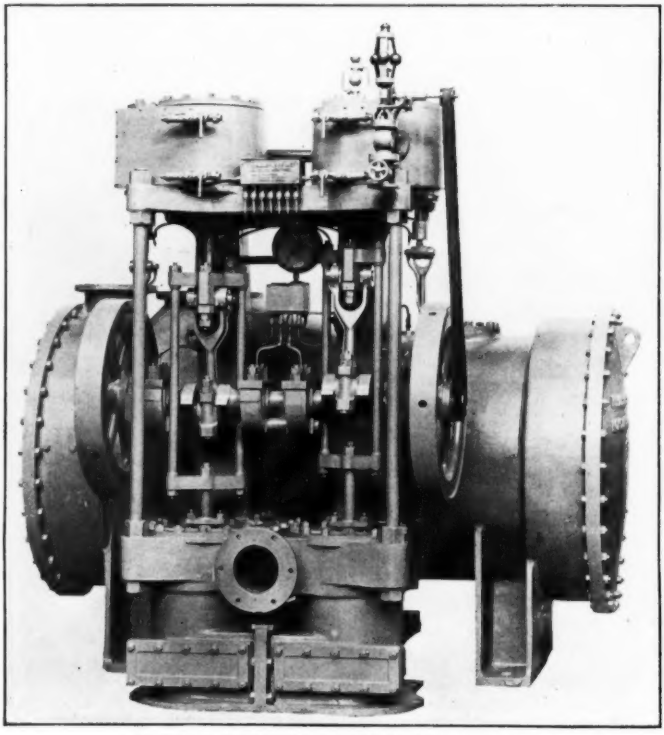


CENTRAL CONDENSING PLANT, GLASGOW.

15,000 lbs. steam per hour; 12 by 10 three-throw Edwards air pump, 11-inch centrifugal circulating pump, 1,500 square feet condensing surface. Messrs. W. H. Allen, Son & Co.

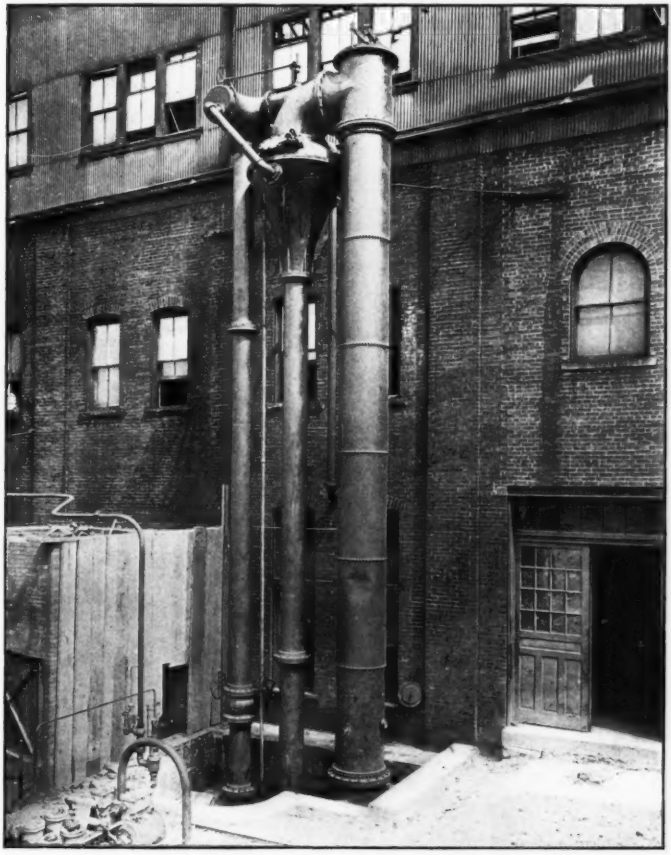
tower it is brought into contact with large surfaces of wood, galvanised-wire meshes, earthenware tiles, or other material.

In the first case a part of the heat is removed from the water by radiation and conduction through the sides of the apparatus. A further portion is carried away by the current of cold air passing through the apparatus; heat is also taken up by this incoming air. A far greater proportion of the heat is removed, however, by the evaporation of the circulating water, for by every pound of this water evaporated a thousand units of heat are carried off, and at the temperature we have to deal with in condensers it is equal to the condensation of one pound of steam. There is a loss, therefore, in the circulating water, due to this evaporation, which amounts to about 75 per cent.



SURFACE CONDENSER WITH CIRCULATING PUMP.

16,000 lbs. steam per hour, 6 and 12 by 6 inch engine, 14 by 6 twin air pump. 150 revolutions per minute. W. H. Allen, Son & Co.

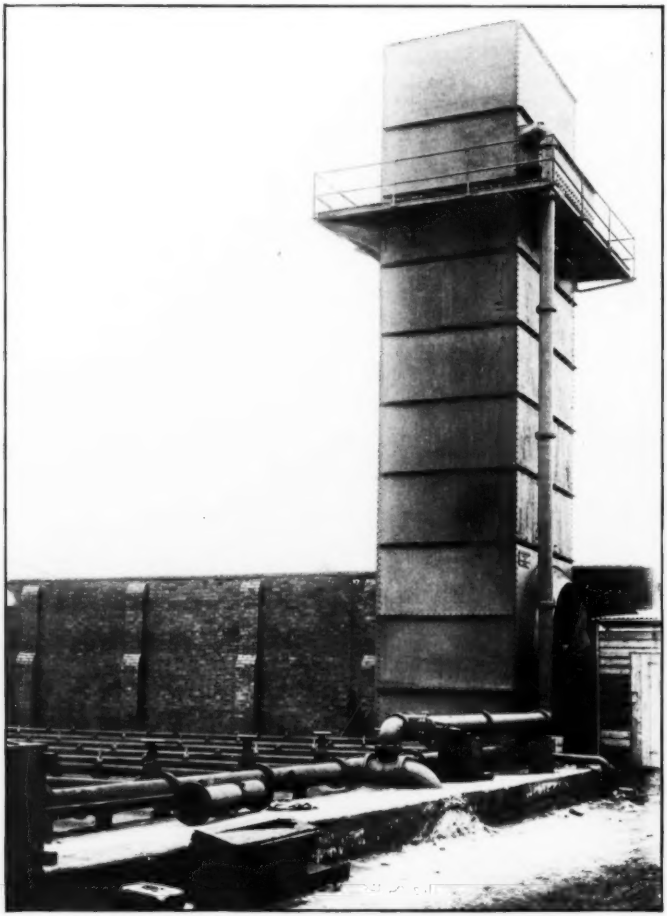


CENTRAL CONDENSER, WEST END TRACTION CO., PITTSBURG, PA.

Capacity about 60,000 lbs. steam per hour; injection water supplied by two compound vertical circulating pumps located in a pit on the river bank some distance away.
Henry R. Worthington, N. Y.

to 90 per cent. of the boiler feed. Under special conditions this loss may be reduced, as in the case of a test by Professor Burstall, at Mason College, Birmingham, with a Worthington tower, when the loss by evaporation was only 58.3 per cent. of the feed water. In this case the air temperature was 51 degrees F., and there was a difference of 3½ per cent. between the wet and dry-bulb thermometers.

The space occupied by cooling towers varies according to the de-



BARNARD WATER-COOLING TOWER OPERATING AT CROYDON, ENGLAND.
Wheeler Condenser & Engineering Co.

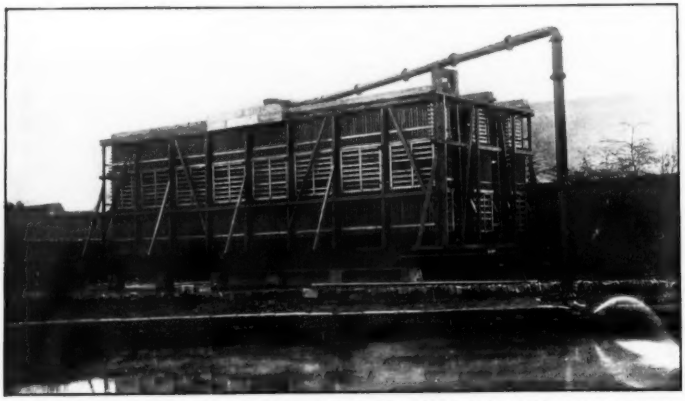
sign. Those with artificial cooling devices take up one square foot per 8 to 12 horse power, while those that depend on natural draught or exposure to the atmosphere occupy a rather larger ground space. The height of the towers varies, but generally within the limits of 30 to 36 feet (for the ground space mentioned), this height being that to which the circulating water is pumped. Where large ground space

is available this height is reduced. These conditions vary considerably, however; it is necessary to provide sufficient cooling surface, and where the ground space is small the height of the tower must be increased; a lower tower would therefore occupy more ground space.

The power required to drive the fans would be from 1 per cent. to 2 per cent. of the total engine power. The circulating pump would require about the same power, making a total of, say, 3 to 4 per cent. for fan and circulating pump.

NATURAL-DRAUGHT CHIMNEY WATER COOLERS, CITY & SOUTH LONDON RAILWAY COMPANY'S GENERATING STATION, CLAPHAM, LONDON.

Dealing with the condensation water for engines of 2,900 indicated horse power. Klein Engineering Co., Ltd.



OPEN TYPE WATER COOLER, MIDLAND MILLS OF MESSRS. JEREMIAH AMBLER & SONS, BRADFORD, ENGLAND.

Deals with condensation water from engines of 800 indicated horse power. Klein Engineering Co., Ltd.

Their cost approximates from 20s. to 30s. per indicated horse power; this, however, varies considerably, according to conditions. Well-designed cooling towers reduce the temperature of the cooling water from an initial temperature of 130 degrees to about 80 degrees F., this temperature maintaining a vacuum of about 26 inches of mercury. When such results are obtained the temperature of the atmosphere would be about 75 degrees F., the humidity not exceeding 85 per cent. Atmospheric conditions decide at what speed the fans should be run. In winter, when the outside temperature is low, the fans need not be run at all for a partial load. Under general conditions, when the load is only one-half to three-quarters of the maximum, the fans may shut down. Provision should be made to vary the speed of the fans.

The accompanying illustrations will give an idea of the general form and arrangement of some of the leading makes of cooling tower. My succeeding article will deal specifically with their working principles, and will conclude with a discussion of the evaporative condenser and its auxiliary appliances.

THE COMMERCIAL ORGANIZATION OF THE MACHINE-SHOP.

By Hugo Diemer.

V.—PRACTICAL AND ACCURATE TIME-KEEPING.

ONE of the most certain signs of good management in a shop is the promptness with which every tool is started to do actual work. Such promptness is insured only by close supervision, particularly at the beginning and closing periods of working-time. Any laxity of foremen during these periods is very likely to have a contagious influence on the men. The mere ringing up or registering on time of the men by no means guarantees that every one of them is at work. The practice of having a preparatory signal three or five minutes in advance of beginning-time, mornings and afternoons, may also be profitably applied to the closing periods at noon and evening. If the workmen are given three or five minutes in which to close operations, the shutting-down will be far less hasty than where but a single closing signal is given.

Of automatic time recorders, the type operated by a swinging lever appears to be meeting with much favor. The registering can be accomplished a little more rapidly than with the key-type recorder and the workman does not need to carry a key with him.

It is customary in some shops to have a factory watchman stationed at the time recorders to see that each man registers only for himself. This is apt to create the impression that the management feels that the men need to be watched. A perfect check may be obtained on each man's time in other and inoffensive ways.

One of the best organized American shops does not use the automatic time recorders, but has a check-board for each section, on which the men hang their checks as they come in. The board is so mounted that it can be swung about a vertical axis. At the final starting signal the board is swung around with its back toward the shop, and as the section foremen's offices are enclosed by wire netting the check-hooks

Prof. Diemer's papers began with the issue of THE ENGINEERING MAGAZINE for June, 1900. The preceding articles have been:

The Systematized Classification of Shop Orders.
The Production Department: Bills of Material.
The Production Department: Store-Room Management.
The Production Department: The Execution of the Work.

are out of reach. The watchman at the general entrance does not require workmen with whom he is acquainted to show their checks unless they are late.

If a man is late and does not have his check with him, it suggests the possibility of some one else having hung up his check, and the matter is reported to the section foreman for investigation. The placing of check boards in the various sections does away with the crowding of men about the main entrance, which is apt to result if three or four time recorders are placed directly at the entrance.

In assigning check numbers it is a good plan to allot a certain number of men to each section or department, liberal allowance being made for growth of the shop, so that a rearrangement need not occur for a long time. Where automatic time recorders are used, such an allowance for growth may require at the outset an additional time recorder, but this original expense may be considered offset by the fact that the additional time recorder accomplishes a little more promptness in registering each day.

The time and cost clerks soon become familiar with the check numbers in the various sections, and if it happens that a vague or incorrect entry of time slips through the shop unnoticed, the workman and the nature of work he is doing are determined by his check number.

The workman's posting of the numbers of orders or sub-orders on which work is done is best examined by the section foreman or his clerk. Where possible it is best to obtain this approval every time work is changed from one order or sub-order to another. In some factories a separate time ticket is issued every time the workman changes from one order to another. This plan has the advantage that all the tickets covering any one order may be fastened together, so that the total time on any sub-order may be obtained from the tickets when the order is complete without any intermediate posting into a book. Where the sub-order system is used, however, and a form employed similar to that illustrated in Paper No. IV. of this series,* the sub-order copies sent to the time-keeping department take the place of the individual time tickets for each change of order, the time for cost purposes on individual sub-orders being posted on the back of the sub-order from the single daily time ticket made out by each man.

With this system a single daily time ticket was used, the form accompanying showing its make-up:

* THE ENGINEERING MAGAZINE, September, 1900, page 894.

DAILY TIME TICKET.

Section.....

Check No...... **Date**.....

	Hrs.	Min.		Hrs.	Min.
Began Work.....					
Shop Order.....					
Sub Order.....					
Tool No.....					
Piece and Operation...					
.....					
			Stopped Work.....		
Totals.....					

The entries are stamped with a time-stamping clock. Wheels containing figures on their peripheries, designating hours and minutes, revolve underneath an inked ribbon and the time ticket is inserted above the ribbon and dated by the striking down of a hand punch from above. The hour and minute appear immediately after the words "Began Work ....," the remainder of the wording shown being permanent on the stencil. The pay-roll clerk subtracts the consecutive figures imprinted by the clock, putting his results into the hours and minutes columns and footing up the total.

In the establishment where the above time ticket was introduced, it had been the previous custom to make consecutive entries of time along a horizontal line on the time ticket. The new form was made narrower and longer, so that the entries would be put underneath one another, since addition in vertical columns was much more convenient to the time-keepers than addition in a horizontal direction.

Premium rates were paid on certain classes of work, but were not recorded on the daily time ticket, the amount of premium being determined by the entries made on the sub-order blanks.

The original object of the sub-order system had been to classify all similar work so that it would be more likely to be done together, and also to determine premium rates.

Having only these two aims in view, time entries were made on such sub-orders only as covered pieces on which premium rates were paid. The general cost-keeping system was continued the same as before the introduction of the sub-order system, namely, by recording total costs for entire general shop orders under certain general headings. In the case of a dynamo, these headings were as follows: Armature Core, Commutator, Armature Coils, Armature Connecting, Series Fields, Shunt Fields, Brushholders and Rockers, Yoke, Base, Assembling, Painting, Testing, Boxing, and in the case of special machines, Patterns, Drawings, and Tools. The foreman of each section had a list of these general headings, and all time was posted under one or another of these headings. When orders were completed, the cost of labor under each heading was compared with previous costs under similar headings for similar machines, and if much variation existed the matter was investigated. As this frequently involved a careful investigation of old time tickets, it is my opinion that it would have been best to post all time from the daily time tickets onto the time-keeping department's carbon copies of all sub-orders, instead of on such only as covered premium-rate work. The sub-order copies would thus serve as the sole cost record, the general book with records by headings being done away with altogether. The sub-order copies would be grouped under distinct headings, just as the time entries in the book had been grouped.

In this scheme, four distinct postings were made from the daily time tickets, viz.: (1) The pay-roll record; (2) The checking against foremen's estimates of time required to do the work; (3) The total-cost book record; (4) The record of individual sub-orders for determining premium rates. The last two entries could be merged together, as suggested above.

For keeping pay-roll records it has frequently been found very satisfactory to use a weekly card, instead of a book, for each employee. The card system has the advantage that any particular man's record may be taken out and examined or laid aside without interfering with the posting. The cards may be conveniently arranged according to check numbers. A form for card for pay-roll record is given on the opposite page.

The pay-roll clerk should also have a double set of permanent-record cards giving the history of each man, one set being that of

present employees, arranged according to check numbers, and the other being an alphabetically arranged set of all men ever employed by the establishment.

WEEKLY PAY-ROLL RECORD.

Week beginning..... .... **Check No**.....

	Straight Time.		Overtime.			Premiums.	
	Hrs.	Min.	Hrs.	Min.			
Monday....							
Tuesday....							
Wednesday..							
Thursday..							
Friday.....							
Saturday....							
Total.....					Total.....		

Straight Time.....hours, at.....
Sunday Time ....hours, at .....
Overtime..... .....hours, at.....
Premiums..... .....

Total .....

The numerically arranged set of present employees need contain nothing further than the man's name and rate, date employed, and date at which he left, its aim being merely to identify men and rates corresponding to certain check numbers. A convenient form for the alphabetical or permanent-record card is as follows:

Name..... Check No.....
Boarding or Rooming Address..... .....
Home Address.....
Application No..... .....
Began Work..... ....
Wages ....
Increase, if any..... ....
Stopped Work..... Why..... ....
.....
Foreman's Report.....

It is of considerable importance to have such a record as indicated above. It makes a valuable record for answering inquiries or giving

testimonials to men, or in re-engaging them, and prevents new foremen from employing men who have been previously troublesome. The "Application No." refers to a file of applications which should be made in writing by every applicant for work. The item "Foreman's Report" refers to the foreman's statement as to the quality of work done by the man, this being usually filled out at the time an employee leaves.

As employees leave, there will be formed a gradually accumulating set of numerically arranged cards, which will be very useful when it becomes necessary to close up orders that have been in the shop for a year or more. With such a set of cards, the calculating of total costs from old postings of time is a simple matter, as the current numerical index shows just when the present employee holding a certain check number was engaged. If the work on any order ante-dates his engagement, the proper rate is obtained by reference to the numerically arranged card index of previous employees.

An instance has come to my notice in which, owing to lack of any systematic method of keeping such records of rates of former employees, the daily entries were made into the total cost record by dollars and cents instead of by hours and minutes. This not only necessitated a multiplication of the time by the rate for each entry, but it also brought about the result that if the armature of commutator of a certain machine showed excessive cost, the record of itself did not show whether the excessive cost was due to the expenditure of an excessive amount of time on it or to the employment of high-priced labor, and the only way to get at the facts of the case was to go back through the files and look up the individual time tickets—a very tedious and unsatisfactory mode of proceeding.

The form of bill of material illustrated in previous papers of this series* provides columns at the extreme right of the sheets into which the time-keeping department inserts the costs of labor. Where no record was kept of the individual sub-orders, the total time and its cost were posted in the bill of material under each general heading, such as armature core, commutator, etc.

It will have been noticed that in the form suggested for workman's daily time ticket an item "Tool No. . . ." appears In any complete system of cost figuring consideration must be given to the relative expense of operating certain tools. Let us consider a large establishment equipped for the manufacture of both heavy and light machinery. Suppose this establishment has a total expense factor of 250

* THE ENGINEERING MAGAZINE, July, 1900, pages 515, 516.

per cent. of its productive labor. Another shop is equipped for the manufacture of light machinery only, and its expense factor is 150 per cent. The management of the larger shop looks at its total costs, derived by adding 250 per cent. to cost of labor on all machines, both large and small, and concludes that for some reason it cannot profitably build small machines. The fact of the matter is that if the tools had the expense account properly distributed among them, it would be found that the large establishment could very likely afford to sell small machinery at the same price as the smaller factory, and that the factor on large machinery should be increased to something like 400 per cent. of cost of productive labor. The small machines are not to blame for the presence in the shop of great, heavy, power-consuming tools, and in figuring costs it is an injustice to the small machines to charge to their account factors not at all involved in their construction. The manifestly proper way to arrive at the expense factors is to determine carefully the relative costs of operating the various tools and establish a certain factor for each individual tool. Besides these individual factors, there will be a general-expense factor which must be added to the total cost, this general-expense factor of course not including the percentages which have been already added to individual tools.

In figuring pay-rolls and total costs considerable multiplication can be saved by preparing a table of various hours and fractions of hours for the particular rates current in any one establishment. The ordinary books for this purpose will be useful in preparing such a special form, but they are usually too voluminous to be serviceable.

In order that the management may be thoroughly conversant with fluctuations in wages and attendance it is essential that the pay-roll clerk make a weekly report covering these points. A form for such a report is given on the next page.

A comparison of these reports from week to week will show whether there is laxity in any particular section, whether it would be good policy to raise wages of certain classes of laborers, whether women and boys are desirable help, etc.

The records of the time required to complete orders in hand may be kept on large sheets of cross-section paper, a sheet being used for each section or factory department, a serviceable form being shown in the second form on page 80.

From the daily report of orders finished, balances are struck, and at the end of each week discrepancies are taken up with the foreman and a report made out showing the work still ahead in each section.

Section.	A	B	C	D	E	Totals.
No. of Men Employed						
No. of Women Employed						
No. of Boys Employed						
Average Rate per Hour, Men						
Average Rate per Hour, Women						
Average Rate per Hour, Boys						
Men Late						
Women Late						
Boys Late						
Men Absent						
Women Absent						
Boys Absent						
Men Discharged						
Women Discharged						
Boys Discharged						
Men Voluntarily Leaving						
Women Voluntarily Leaving						
Boys Voluntarily Leaving						

SECTION..... WORK IN HAND.

Order No.....	5027	5028	5029	Etc.
Estimated Time	130	26	45	
DATE				
1.	20	16	4	
2.	20	4	11	
3.	20		11	
Etc.				

The forms shown above have been found useful in certain shops. The devising of a system to fit a particular factory will necessarily require the exercise of some judgment and originality. The development of methods of time-keeping should be a matter of careful planning, and needs to be undertaken by a person possessing a wider knowledge of the business than the clerk employed to post the time. The work of time-keeping is so intimately connected with that of cost figuring that the rational head of the time-keeping department will in most establishments be the person in charge of the cost department.

THE THOUSAND-MILES AUTOMOBILE TRIALS.

By W. Worby Beaumont.

THE thousand-miles trials of automobiles carried out by the Automobile Club of Great Britain and Ireland last June will ever remain the most important event in the motor-vehicle world of the year 1900. About sixty thousand miles were run by the vehicles under observation, and it is as difficult to overestimate the value of the experience gained as it is to impart a notion of it to those not concerned.

ARRIVAL OF THE TWO GREYHOUNDS OF THE TRIAL, A10 AND A17, NEAR BATH.

A million is a number which is big enough to convey the idea that a few more make no difference, so when it is stated that the total number of the revolutions made by the road wheels of the competing vehicles in covering that 60,000 miles was about 40,000,000, it will be allowed that that was enough to show up any defects. The wheels and axles may, however, be said to be very simple parts, so it may be mentioned that the collective revolutions of the crankshafts of the engines of the vehicles were about 70,000,000, and this means that the pistons of those engines made from 210,000,000 to 216,000,000 strokes, and the admission and exhaust valves not less than about 200,000,000 millions of strokes, or openings and closings.

These as well as the gear wheels are vital parts, and it needs no argument to show that such enormous numbers of repeated wear-causing and strength-testing operations could not have been made with machines very unfit for their work, or without teaching many lessons which, when fully utilised by those manufacturers who are susceptible of instruction and capable of putting it into practice, must lead to far-reaching developments.

The vehicles entered for trial were divided into two sections, namely, those entered by manufacturers and those privately-owned and driven by the owners or their substitutes or servants.

These two sections were divided into four classes, based upon the selling price of the vehicles—

Class A.—Cars declared at a selling price of £200 or less.

Class B.—Cars declared at a selling price of more than £200, but not more than £300.

Class C.—Cars declared at a selling price of more than £300, and not more than £500.

Class D.—Cars declared at a selling price of more than £500.

Class E.—Motor Cycles.

(*a*) Tricycles.

(*b*) Tricycles or quadricycles for two persons or more.

Class F.—Vehicles for public service.

There was a further section for parts of cars, but under this section only one entry was made, namely, of "Clipper" tyres. Of eighty-three vehicles entered for the trial, sixty-five started from Hyde Park Corner; but several of these could hardly have been expected to get through the tour and trials, and one at least has shown that even the best organisation may be perverted to unscrupulous business uses. Of this number, thirty-nine are recognised officially as having gone through the 1,000 miles with complete records, and climbed all the hills except the Shap Fell, which was optional. Ten others, with more or less broken records, arrived, and were exhibited at the Crystal Palace Exhibition, which opened on the 14th May, making a total of forty-nine. Of this number also fourteen entered and ran through the speed trials in Welbeck Park. The hills included:

Taddington Hill, 13,320 feet long, rising 651 feet, with most of grade varying from 6 to 8 per cent.

Shap Fell, No. 1, 38,300 feet long, rising 840 feet, steepest part a grade of 6.5 per cent.

Shap Fell, No. 2, 7,338 feet long, rising 500 feet, steepest part a grade of 10 per cent.

THE START. CARS IN FILE AT OUTWARD CONTROL FROM LONDON, AT HOUNSLOW, ON BATH ROAD.

Dunmail Rise, 9,040 feet long, rising 450 feet, steepest part 650 feet of 9 per cent. grade.

Birkhill, 10,500 feet long, rising 460 feet, steepest part 9 per cent. grade.

All the vehicles with three exceptions were propelled by gasoline or mineral spirit internal-combustion motors, chiefly of the Daimler and Dion-Daimler types. The exceptions were two steam cars with boilers heated with mineral spirit, namely, a Stanley "locomobile" with two seats; a Whitney car with four seats, and a Roots & Venables kerosene-motor car.

It has been pointed out that all the automobiles that went through these trials did so under conditions that were very different from those that would obtain in the ordinary service of any user. There was no compulsion as to speed, but every vehicle had to "get there" at the end of a certain number of hours, or be beaten in comparison with those

BAD FOR THE NEXT CAR.

A17 raising the dust near St. Albans after a run of 1,100 miles. Taken from the back of the car at 36 miles an hour.

that did, or lose marks. Such a trial was, therefore, a competitive trial all the way, although anything like racing was deprecated, and stringent regulations were made for low speed through the towns and districts under "control."

The trials were endurance and hill speed tests; economy as to fuel and water was not made a condition simply because this was not necessary, and because observations and records could not be made without a staff of observers which no club organisation could supply. Watching, measuring, and recording of the petrol and water and lubricating-oil consumption throughout all sorts of country, over about 1,100 miles of roads, by automobiles which were at the start over sixty in number, would have been much more expensive than useful. The cost of the fuel per person is unimportant in comparison with other costs, and is in no case the determining cost. Moreover, the club conducts, once a quarter, a hundred-mile hill and consumption test of any vehicles presented, and the results are published. From these the efficiency of many of the motors and their vehicles is known.

The total distance to be run was 1,050 miles, not including an optional separate hill-climbing test up Shap Fell. There was also an optional speed trial on the private roads of Welbeck Park, the property of the Duke of Portland; this added about 28 miles, including the distances run at speed, to the total travel of the fourteen vehicles entered. Several hundreds of the miles of road covered were of the average good surface of English roads, but there were at least two hundred of the very bad surfaces in and near towns and on some of the very hilly districts, which are still too common, and for which the whole country pays very dearly.

In the open country on good roads, and where no one was looking, some very high speeds were occasionally made, one or two cars reaching over 40 miles per hour; but the great value of the trials lies in the proof: 1, of the endurance of the vehicles and their mechanism; 2, in the proof of hill-climbing powers; 3, in the test of mechanical efficiency of the transmission gear; 4, in the proof of the endurance, capabilities and the possibilities of the smaller types of cars or voiturettes; and 5, in the tests of wearing powers of pneumatic and other tyres.

The greater number of the cars were built on the Panhard & Levassor and on Benz lines, with Daimler and with Benz petrol motors, but nearly all well-tried types were represented, as the following descriptive list will show:

In class A, which may be called the voiturette class, there were two Benz light "Ideal" cars, both driven by single cylinder 3 horse-power Benz engines, the one by two belts from motor shaft to chain pinion shaft and with small epicyclic gear inside one of the driven pulleys for the slow speed; the other by one belt from motor shaft to a pulley on a spindle in a box containing three-speed gear. The general construction and the arrangement of these cars are well known. They were numbers 1 and 2, and weighed 13.25 and 13 hundredweight with passengers respectively, and both were fitted with Conolly solid tyres, which stood remarkably well and gave no trouble. The mean actual power given off at the road wheels on the hill climbing trials was by No. 1, the belt drive, 1.53 horse-power, by No. 2 belt and gear drive, 18.9 horse-power: and the mechanical efficiency of the whole of the transmission gear was thus 0.51 and 0.61, respectively.

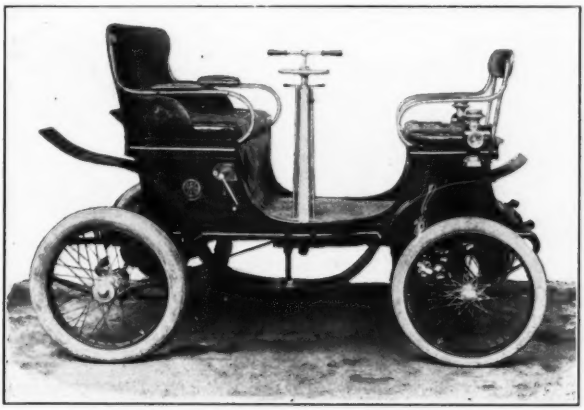
BENZ CAR NO. 2.
First prize in Section I., Class A.

The locomobile or Stanley steam car, No. 5, weighing 9.25 hundredweight, with passengers, and of 3 horse-power (nominal), went through the trial, but every part of it except the frame was sorely tried under the heavy ordeal. The single-tube tyres gave a great deal of trouble, the boiler primed a good deal, owing to insufficient size, occasional impure water, and (it was stated) to the introduction of something other than water; axle adjustments were found to be wanting and all bearings and the connecting-rod ends were as much worn as they could be and yet struggle to a finish. The trial showed, however, just where the weak points were and that improvements could be easily made with a few pounds more weight of metal, which would not detract from the good points in the car and its hill-climbing capacity, which was good. The framework and undergear of this carriage are especially deserving of notice. The apparent extreme lightness and yet now obvious sufficiency in almost all particulars are very suggestive. Although the frame may be said to be cycle

A17, HON. C. S. ROLLS' 12 HORSE-POWER PANHARD, AND A10, MR. KENNARD'S 8 HORSE-POWER NAPIER, ON THEIR RETURN TO ST. ALBANS.
Gold medal and first prize, respectively.

makers' work, it must be remembered that the design has to be schemed out before the cycle frame maker can get to work. The steam car has, however, against it the much larger consumption of petrol than by petrol motors; and, so long as it is without a condenser, the disadvantage of a stop about every hour and half or two hours for water. The average actual horse power shown by the hill

trials was 1.83, and the mechanical efficiency 0.61. The Gladiator voiturette, No. 16, is propelled by a small water-cooled motor of the de Dion type, nominally of 3 horse power, but obviously of much lower power. The motor drives by chain from the motor shaft to an intermediate shaft with epicyclic gear and clutches to give two speeds. A second chain from the shaft gives motion to differential gear on

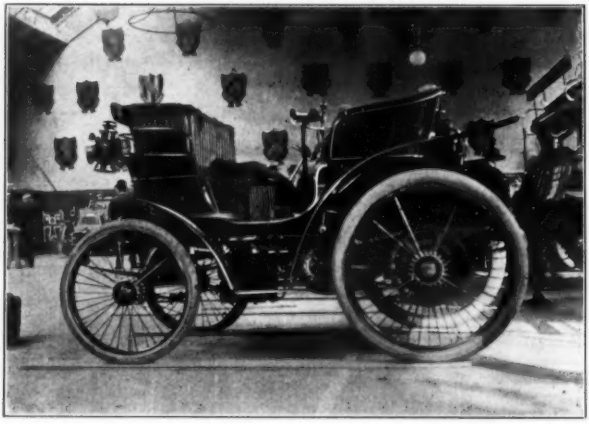


3 HORSE POWER VOITURETTE OF DE DION & BOUTON.

Third prize, Section I., Class B.

the live axle at the back. The speed of this car was low on the hills, but high on the levels. With passengers it weighed 8 hundredweight, the maximum horse power shown at the driving wheels on any of the hills was 1.24, and the mechanical efficiency 41 per cent.: the mean horse power on the hills was, however, lower than this, and the mechanical efficiency correspondingly so. The transmission gear is on the whole simple, but the extra pull on the bearings, chain, and gear seemed to have added very materially to the resistances when the motor was doing its most on the hills.

Another type of vehicle was presented in the "New Orleans," No. 27, which has an air-cooled motor in the front, of nominally 3 horse power, de Dion type, and driving, by one long belt, simple two-speed gear of the planing-machine type on the main axle at the rear. This car weighed 8.5 hundredweight, with its two passengers, gave a maximum of 1.28 horse power at the wheels on one of the hills, and a mean of 1.07 horse power on the hills, mechanical efficiency of 0.425 and of 0.36 respectively. The performance of this



A29, MR. MAYHEW'S 7 HORSE-POWER PEUGEOT CAR, IN BRISTOL DRILL HALL.

light car was also very good, and it is a type which has already several sincere flatterers.

Two Decauville cars, Nos. 33 and 34, also went through the trials. These were driven by a pair of air-cooled motors of nominally 3.5 horse power at the rear of the vehicle, driving a live rear axle by bevel and spur gear, with shifting pinions for change of speed. The maximum horse power given by either of these at the road wheels was 1.23 and a mechanical efficiency of the better car 0.39, taking the mean hill performance; these cars weighed only 8.75 and 8.5 hundredweights respectively, including passengers. The more recent patterns of Decauville cars include several modifications which will improve them as to comfort, and make them less noisy.

No. 41 and 44 were two "International" Victorias. These are almost identical with the No. 1 Benz; that is to say, they drive by belt from motor to chain pinion shaft; their mechanical efficiency was 0.43 and 0.46 respectively.

The Star voiturette, No. 51, was another vehicle of precisely the same class. Its mechanical efficiency was 0.54, but it had several mishaps.

All the cars mentioned in the preceding Class A are separated from Class B only by price.

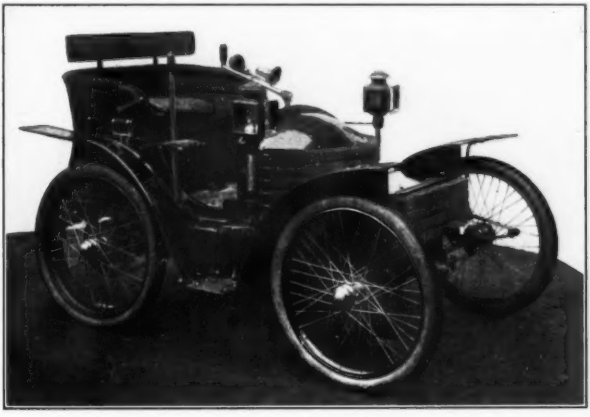
In Class B were two Marshall cars, which are practically the same as the Benz and Hurtu cars, but their performance was not as good.

Two Dion voiturettes, weighing 7 hundredweight, or 9.5 hun-

dredweight, with passengers, went through the trials, and one of them showed a mechanical efficiency of 0.61 and a mean horse power of 1.84. These cars are driven by 3 horse-power water-cooled de Dion and Bouton motors through two-speed friction-clutch gear, the motion being transmitted to the rear driving wheels by jointed rods on the de Dion system. The motor and gear are carried by the car body, and the jointed rods referred to permit its rise and fall under the action of the springs.

Another car of this light type, Nos. 31 and 32, was the Renault, which weighs but 6.5 hundredweight, without passengers, or 9 hundredweight with passengers. It is driven by a 3 horse-power water-cooled de Dion motor under a bonnet in the front, driving through a cone clutch and change-speed gear of the lathe and mowing-machine types, this gear giving motion to a jointed rod running fore and aft of the carriage, and driving the live rear axle by bevel pinion and bevel wheel on the outside of the differential gear. One of the two Renault cars ran very well and at considerable speeds; the maximum power was 1.75 horse power and the mechanical efficiency reached 0.58. The frictional resistance of the transmission gear is thus smaller than that of several of the other light cars, but like several other voiturettes it is noisy.

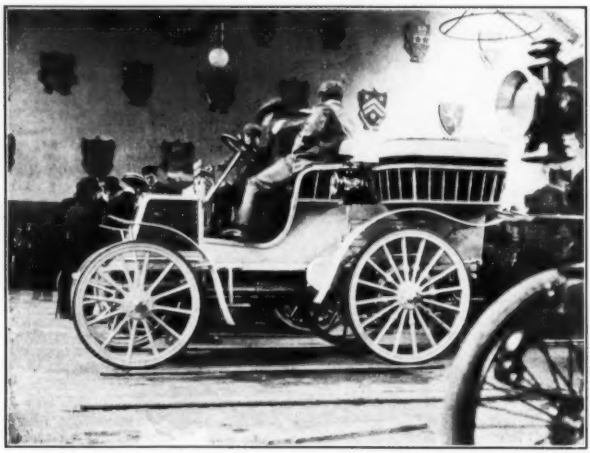
The car in this class of most originality was No. 40, namely, the Wolseley voiturette. It is shown by the accompanying photograph. This car ran exceedingly well throughout the trials and on the hills. The motor was entered as of 3 brake horse power, but in the works



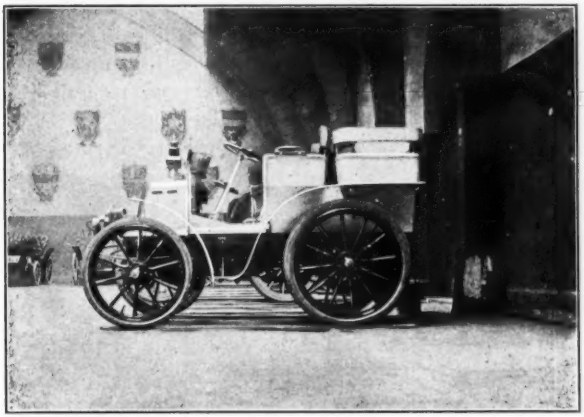
WOLSELEY VOITURETTE, NO. 40. SECTION I. CLASS B.

had given on the brake, when new, 3.3 horse power at normal speed of 700 revolutions per minute. On the trial, however, it was always run on the throttle valve and without doubt often ran at 900 revolutions per minute, which would bring the power up to at least 3.6 horse power. The mean effective horse power required at the road wheels on the Taddington hill trial was 2.83, when three passengers were carried. At this time a low gear was in use, and the engine running at not less than 800 revolutions per minute, giving 3.75 brake horse power, which, with 2.83 horse power at the road wheels, gives a mechanical efficiency of 0.75, which is extremely good.

Turning now to some of the heavier cars, we come to Class C, and here we have cars on the Panhard & Levassor and the Peugeot lines. A large number of these must be grouped together, namely, fourteen 6 horse-power Daimler motor vehicles, either of the Panhard or of English construction on Panhard lines, two forms of which are illustrated. Of these it is only necessary to say that their average performance was good, and that their mechanical efficiency is from 0.5 to 0.6. Some of them as made in Coventry are known as the Parisien Daimlers, and their running and hill-climbing was in every way satisfactory. They have more substantial gear than the similar Panhard cars, and, though high priced vehicles, are among the best yet made. The general arrangement of the gear is that



6 HORSE-POWER DAIMLER WAGONETTE, NO 36, LONG WHEEL BASE, IN BRISTOL DRILL HALL.
A First Prize.



A2, MR. BUTLER'S 6 HORSE-POWER PANHARD TONNEAU CAR IN BRISTOL DRILL HALL.
Silver Medal.

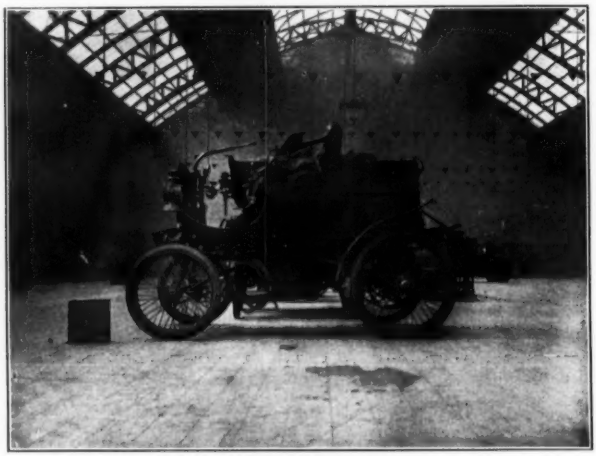
shown in THE ENGINEERING MAGAZINE for September, 1897, page 960; but great improvements have been made in every detail and in the motors. The spur wheels and pinions have been made wider, stronger and much more durable. The brakes have been made stronger, and one at least of them acts in both directions. The steering gear has been strengthened, and, being operated by worm and quadrant, is self locking. The motor gives more power for the same weight than formerly, and will run at any speed, by throttling, from about 300 to 1,200 revolutions per minute.

The Whitney four-seat steam car, No. 23, with chain drive to live rear axle, got through the trials with many instructive troubles which befell nearly everything but the framework. A Renold saw-tooth chain was used, and one of its links broke at a pin hole, stood up, and sawed a hole through the bottom of the water tank, which was too near. A different chain and more clearance will be used in future, and much greater accessibility of engine must be secured. Nuts came off one of the crankshaft bearings. The results are just as well imagined as described; the nuts will not be allowed to come off again. The tyres, which were very thick single-tube pneumatics, gave no trouble, and wore exceedingly well.

The Richard cars, Nos. 46 and 47, which have belt, gear, and chain drive, went very well indeed through the trials. They carried four passengers, including driver, and although the machinery is not so accessible as in some of the other cars, it seldom required the whole

of the time allowed for adjustments or repair at the stopping places. The total weight was about 21 hundredweight, or 16 hundredweight without passengers. Two passengers had to descend during part of the Dumrail Rise climb. The brakes are too slight, and will not act properly for a backward stop.

The Lanchester car, No. 22, went through the whole trial, but



WHITNEY STEAM CAR, NO. 23, IN THE DRILL HALL, SHEFFIELD.

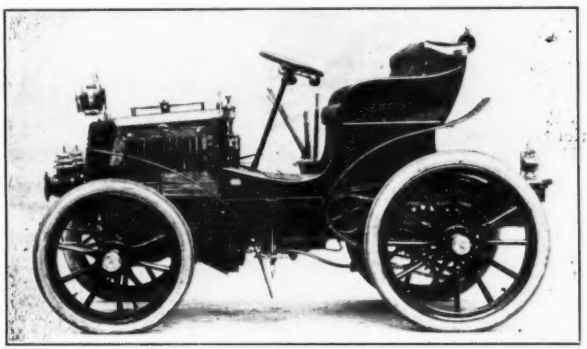
ignition difficulties gave trouble the last few days, causing considerable delay and preventing the appearance of the car at the stopping places on the last two days. This car has a two-cylinder 8 horse-power motor with two connecting rods to each piston. These rods work two cranks, geared together and running in opposite directions. On each crank is a fly wheel, one of which carries bar magnets for generating the ignition current, and the other carries fan blades for cooling the motor cylinders. One of the cranks is continued aft, and there, by means of two alternative clutches, drives a worm which gives motion to a worm wheel on the live driving axle. The object of the form of motor chosen (Patent No. 10,836, of 1898) is to secure balanced running at all speeds. For the trial a lower pitch of worm than had previously been used was fitted and the speed of the car reduced, and this may have contributed to the low efficiency of the gear, as shown by the hill-climbing, which was only about 0.32. As, however, the efficiency was only a little higher than this on the previous trials with the higher-pitch worm gear, it must be assumed that the efficiency of the transmission is not what was expected, that the

air-cooling fan takes much power, and that, as in other air-cooled cylinders of this size, the power falls off on a long, heavy pull.

Among the smaller comfortable two-seat voiturettes was the Mors Petit Duc of Mr. Phillips in Section II., No. A, 24. This car weighed with passengers 13.5 hundredweight, and is fitted with a 4 horse-power water-cooled double-cylinder motor placed transversely under a bonnet in the front; the crankshaft extending rearward drives a chain pinion shaft through three-speed gear. This car worked exceedingly well throughout the trials, the only stoppage of any note being due to an electrical defect which could have been remedied in one minute with more exact knowledge of the arrangement of the circuits. As in many other cars, there are details which may be easily improved, and this applies in particular to the governor gear; the efficiency of the car works out to about 0.54.

It is not necessary to describe other cars at length, but particular reference may be instructively made to the performance of two other vehicles, namely:

No. A10, the 8 horse-power Napier, driven by Mr. S. F. Edge; and No. A17, the 12 horse-power Panhard, of the Hon. C. S. Rolls, by whom the car was driven. Both these cars have an apparent



A17, HON. C. S. ROLLS' 12 HORSE-POWER PANHARD & LEVASSOR CAR, DICKEY SEAT REMOVED.

First prize in Section II., Class D.

efficiency of 0.82. This is based on the total weights and on the brake horse power entered by the owners. Both of these motors were, however, practically run without any governor, and their normal speed was very considerably exceeded. It will certainly be no exaggeration if a speed of 850 revolutions per minute be assumed as that which obtained on these hill trials, and it is possible that it was

more than this if the gear which could be used was a low one. Even allowing, however, for Mr. Rolls' remarkable skill in driving, and manipulating his speeds and mixture adjustments, it cannot be for one moment supposed that this skill and attention raises the mechanical efficiency of the transmission gear of his Panhard car to anything like 82 per cent. Nor can it be admitted that this has been reached with the 8 horse-power Napier-Daimler car. Indeed, the consideration of the speed trials confirms the supposition that the actual power of the motor was very largely increased by increase in the number of revolutions.

The measured mile on which these trials were run was by no means level, the gradient reaching in one place 1 in 26.1, and the total rise being 70.37 feet, or 1 in 72.5. The surface of the road was excellent, and there was no noticeable wind. Fourteen cars took part in the trials, with the results given in the following table:

WELBECK PARK TIME AND SPEED RECORDS.

No. of car.	Description.	Time uphill.	Time down hill.	Mean time.	Average miles per hour of mean time.	Average miles per hour of down-hill time.
		M. S.	M. S.	M. S.		
A17	12 H.P. Panhard, Hon. C. S. Rolls's...	1 46 4/5	1 24 3/5	1 35 3/5	37.63	42.55
A4	8 H P. Panhard, Mr. Mark Mahew's...	2 17 3/5	1 45 4/5	2 1 2/5	29.60	34.02
A10	8 H.P. Napier, Mr. Kennard's.....	2 16	1 47 3/5	2 1 3/5	29.50	33.51
4	Ariel tricycle with Whippet trailer.....	2 11 1/5	1 53 1/5	2 2 1/5	29.45	31 80
A22	12 H.P. Daimler, Mr. J. A. Holder s..	2 34	2 0 2/5	2 17 1/5	26.23	29.90
A11	12 H.P. Daimler, Hon. J. Scott Montagu's	2 38 1/5	1 57 4/5	2 18	26.08	30.56
39	Century tandem tricycle.	2 34 3/5	2 24 2/5	2 29 2/5	24 09	24.93
16	3 H.P. Gladiator voiturette.....	2 48 3/5	2 22 1/5	2 35 2/5	23.16	25.31
A31	6 H.P. Parisian Daimler, Mr. Johnson's	3 1 2/5	2 10 4/5	2 36	23.07	27.52
40	3 H.P. Wolseley voiturette	3 1 1/5	2 14 3/5	2 37 4/5	22.81	26.74
14	3 H P. De Dion voiturette, ...	2 54 1/5	2 33 4/5	2 44	21.70	26.00
A3	6 H.P. Panhard, Mr. T. B. Brown.....	3 26	2 12 2/5	2 49 1/5	21 27	27.19
A2	6 H.P. Panhard, Mr. Butler's....	3 10 1/5	2 28 1/5	2 49 1/5	21.27	24.13
15	3 H.P De Dion voiturette.....	3 22 4/5	2 47 1/5	3 5	19.45	21.53
—	7 H.P. Peugeot, Mr. Lord's.....	2 45	1 58 1/5	2 21 3/5	26.97	30.45

All the above trials, with the exception of Nos. 4 and A 2, were made with driver only on board.

From this table it will be seen that four vehicles ran at considerably over 31 miles per hour on the down grade, and nearly 30 miles per hour mean speed up and down grade; while Mr. Rolls' car reached 42.55 miles per hour down hill, and 37.63 as the mean of the up and down grade.

Now the actual work done in propelling this car at the mean

speed of 37.63 miles per hour is only 4.46 horse power, while the air resistance at that speed equals 8.06 horse power, making a total of 12.52 horse power. In estimating the air resistance, head resistance only being considered, the head wind area is taken as 15 square feet, which is as near the area as can be ascertained. Assuming an efficiency 0.75 or 75 per cent. for the transmission gear, the actual power of the motor was 16.7 horse power. This being the case, the motor speed must have been increased from the normal of 750 per minute to at least 1,040 per minute. On the hill trials, therefore, Mr. Rolls may have been using anything between 12 horse power and 16.7 horse power, depending partly upon the particular pair of speed gear wheels he was able to use. Thus, assuming that he was able to use a low gear and a high speed of motor, and thus get, say, 15 horse power out of the latter, the true mechanical efficiency of the transmission gear would be 65.5. It is thus obvious that, unless the hill-

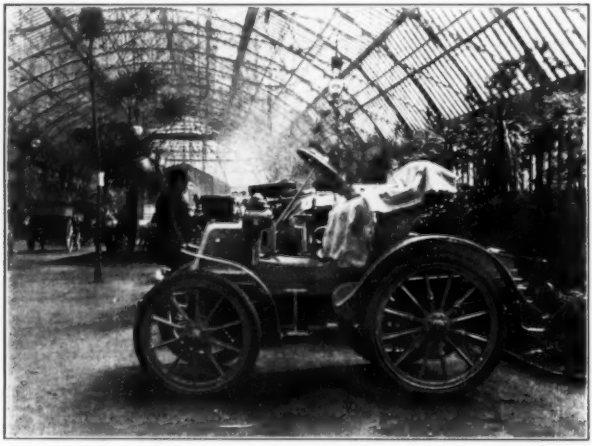
MR. HARMSWORTH'S 12 HORSE-POWER PANHARD CAR, 1900 PATTERN, AT CALCOT PARK.

climbing trials were conducted with a known speed of motor, the true mechanical efficiency cannot be obtained.

The 8 horse-power Napier car of Mr. Kennard, which is fitted with a Daimler motor with slight modifications, and was driven by Mr. S. F. Edge, had an apparent mechanical efficiency exactly the same as that of Mr. Rolls' car, namely, 0.82, or 82 per cent., and the speed trial gives an efficiency of 87.8 per cent. if the motor be taken as only of the power stated. Of the total power accurately used, 3.58 horse power represents the net work of propelling the car at the

speed observed, and 3.43 horse power the work done against air resistance, or a total of 7.01 horse power, the head area being in this case taken as 14 square feet, instead of 15 as in the case of Mr. Rolls' car. The motor was probably running at about 1,000 revolutions per minute and giving about 10 horse power.

Considering the general excellence of the machinery of Mr. Kennard's car and its performance on the hills, it might have been expcted that it would have given a higher speed on the Welbeck Park road; but as the motor was driven throughout the tour without a governor, it may be said to have been "accelerated" during the whole



A31, 6 HORSE-POWER "PARISIEN" DAIMLER, IN BOTANICAL GARDENS, MANCHESTER. Silver Medal.

of the running, and there was little to call upon when the higher speed of rotation was required.

The same remarks obtain with regard to the Wolseley car, which was run during a great part of the tour on the throttle, and not with a governor. On the speed trial the tractive work was 1.75 horse power and the air-resistance work 1.18 horse power, with a head area of 10 square feet, giving a total of 2.95 horse power. Thus, assuming a mechanical efficiency of 0.75, the motor was obviously capable of giving 3.92 horse power, and this would give a true mechanical efficiency of 68.5 per cent. This is high, and is about what might be expected from the car. It is unnecessary to follow out this examination to more of the cars, but the generally excellent behaviour of some of the 6 horse-power Daimler Parisien cars makes it desirable

to refer to them. Taking one of them, A31, which made a mean speed of 23.07 miles per hour, and a speed of 27.52 miles per hour on the down grade, it will be noticed that the difference in the uphill and downhill speeds was greater than with the previously mentioned cars. This car, having a 6 horse-power motor, weighed with passengers 2.45 hundredweight, while the Panhard, with its 12 horse-power motor, weighed but 26.25 hundredweight. Hence the weight of the car with the 6 horse-power motor tells heavily against it on the uphill, and gives an apparent disproportion between the uphill and downhill speeds, which would not of course be found with the 12 horse-power car. This is apparently not in agreement with the figures obtained with the 12 horse-power English Daimler cars; but in one at least of these cars, namely, Mr. Holder's, the weight is excessive, and the motor was only giving on the speed trial 8.4 horse power, assuming 75 per cent. efficiency of transmission. On the other hand, with Mr. Johnson's 6 horse-power car, the tractive work was 2.54 horse power, air-resistance work 1.68 horse power, or a total of 4.22 horse power. With similar performance Mr. Holder's motor should have given 11.2 horse power, Mr. Johnson's motor giving 5.62 horse power for the 4.22 horse power at the wheels.

One of the noteworthy results of the great trial is the confirmation that it affords of the continuous working capacity of the little high-speed motor which so many engineers and others not acquainted with its performance under severe conditions seem to think is the vulnerable part of a motor carriage. It may safely be said that, on the whole, the motor itself may be depended upon to give less trouble than any other part of the car machinery. There are, no doubt, many motors in which slight modifications of the lighter parts, which are too light and have insufficient size and strength in joints and pins, will reduce the number of stoppages for slight adjustments and for repairs. These, however, the experience now obtained will make easy. That "it is the pace that kills" has been once more proved by these trials. The old adage must, however, be used with qualifications when applied to the motor car. The effect of speed and weight together is as certain with regard to the automobile as with the horse, but the horse cannot escape the effect of speed and continuation of effort though he may be bred for speed. The motor vehicle can, however, escape this to the extent that continuation of effort has no more serious effects than consumption of fuel and wear of renewable parts. When, however, the attempt is made to run the motor equivalent to the heavy horse at the speed of the light one, then

the limit of endurance of the renewable materials is so rapidly reached that cost precludes commercial practicability. The lighter forms of motor vehicles may run at double or treble the speed which a carriage horse can maintain, and do so almost continuously for the number of hours per week that any driver would care to travel. On the lighter cars good pneumatic tyres were little or no trouble throughout the tour, and they returned in good condition, one of the two elements necessary to the destruction of the rubber, namely, weight or pressure, being absent. On the other hand, even the best tyres on the heavy cars suffered severely, and experience showed that the cost of fuel per mile run was not more than from one-fifth to one-half the cost of the tyres. It is, therefore, only half the truth to say of motor cars that it is the pace that kills; for, so far as tyres at least are concerned, it may equally be said that it is the weight that kills. The limit to weight which rubber can carry, without easy destruction at common speeds, has already been reached, both with pneumatic and with solid tyres; but the limit to improvements which will reduce weight is at present far off, and high speed for other than mere racing purposes need not be always prohibited on the ground of cost of tyres. The very slight wear of the solid tyre of the Benz cars, after nearly 1,100 miles' running, was very remarkable; it proved that moderate speeds and light weight had very little effect on the rubber used; on the other hand, some of the solid tyres on the heavier cars, though wider in proportion to weight, were not only severely cut and worn, but were very much deformed and loosened in the part held in the rim.

In a good many instances a very objectionable exhaust was given off by cars in which it is known that the combustion is generally very good. In some of these cars this was due, no doubt, to improper adjustment of air and petrol; but in several instances it was due to the unsatisfactory character of the lubricating-oil adjustment and admission. There can be no doubt that a mechanical lubricator which acts only when the motor is running would prevent the frequent recurrence of this objectionable exhaust, doubly objectionable because it is always worst immediately after starting, which is generally done before a crowd of spectators.

It is somewhat remarkable that, after all the experience which makers have had with the pumps for circulating the cooling water, so many troubles and failures should still occur with this detail. There ought to be no difficulty whatever in making and applying a suitable pump for this job which would run continuously, if necessary, for a whole year.

EDITORIAL COMMENT

The hugeness of the wreck at Galveston can hardly yet be fully seen, but, unlike most disasters, it seems to have been minimised in the earlier reports, and to make the losses and sufferings of war appear small by contrast. It is yet too soon to forecast accurately its future influence, or to draw inferences, except, perhaps, that ordinary protection and ordinary structures are insufficient to withstand the forces of ruin which may attack a city built only a few feet above the sea and within the hurricane zone. The storm, however, seems to have been entirely without precedent, so far as recorded observations go, and, as one commentator remarks, "there has been but one Lisbon earthquake."

It is not unnatural that some despondent authorities should consider the ruin final; on the other hand, the general determination seems to be to raise the city up again, more powerful and prosperous than ever, and secure for all time against even such fury as that of the late storm. A great deal depends on the action of the Southern Pacific Railway. It has generally been believed that Mr. Huntington was pushing Galveston developments against the opposition of most of his directors. The present executive head of the road, however, asserts that they will certainly rebuild. Geographical and economic conditions indicate Galveston as the great port of the southwest. The sympathy and backing of the United States are behind her. We venture to predict that she will recover as Chicago did from the fire, Charleston from the earthquake, or St. Louis from the tornado.

* * *

Coincident with the new and important movement toward the export of American coal—a movement whose meaning and value to the old world and the new is clearly shown in our leading article this month—comes the menace of a coal strike which, by the estimates of the labour leaders themselves, will be "the most serious and disastrous episode in the history of the American coal industry."

It is true that the movement so far is confined to the anthracite field, which is not directly concerned in the rising export business; but to an appreciable extent the anthracite and bituminous fuels are competitive in the States, and the soft-coal market cannot fail to be importantly affected by difficulties in the hard-coal trade. It is a deplorable event for manufacturing, engineering, and commercial interests everywhere—the more so as the consensus of outside opinion seems to be that the strike is inexcusable. It centres apparently on the old question of "recognition of the union." The relations of operators and workmen generally are said to be good, work abundant, and wages satisfactory. The stated grievances are the "company store" and the price of powder—the latter a chronic one; it has been the custom to charge the men an arbitrary price for powder, but this has been offset by higher wages. The practice is a bad one, as the men see and object to the direct charge, and do not recognise the indirect offset. The operators aver, however, that no grievances have been presented to them by their workmen, but that demands are made upon them by the United Mine Workers, an outside organisation seeking to control both employees and employers. The struggle apparently can bring only distress and suffering to the men, loss to the operators, and injury to industry everywhere. It is deplorable that no means were found to avert it.

The working world must awaken to a controlling knowledge of the utter wastefulness of war. Mr. Skelton, elsewhere in this number, speaks of the "periodical irruptions of hostile feet" which have so often and so painfully crushed the industrial rise of the European continent. The worst wreck of all is that caused by the trampling of fighting factions within the social fabric of the nation. After the lessons of the British engineering strike, the lately-threatened American machinists' strike, and the evident efficacy of reason and arbitration as displayed in other great trades, a strike like this is a folly and a crime.

* * *

The exhaustive discussion by Mr. Maynard, in the August issue of THE ENGINEERING MAGAZINE, upon the relative cost of horse and mechanical traction upon common roads, has brought attention to the very interesting examination of the same subject made by Oliver Evans so long ago as 1804.

We are indebted to Mr. Henry G. Morris, of Philadelphia, well known in connection with the development of electrically propelled vehicles, for a copy of the proposal made by Oliver Evans to the Lancaster Turnpike Road Company, advocating the introduction of the steam wagon which he had already made.

This interesting document, which we have not space to reproduce in full, gives a detailed estimate of the cost of horse wagons and equipment equal in capacity to the steam wagon, the general comparison being as follows:

Steam wagon capable of carrying 100 barrels of flour at a rate of three miles an hour on level roads, or, on the average, forty miles in twenty-four hours, is put at $2,500, while the cost of five horse wagons and equipment of equal total capacity foots up $3,304.15, a difference in favor of the steam wagon of more than $800 in first cost.

In regard to operating expenses, Evans shows that the cost of one journey from Philadelphia to Columbia, made in two days by the steam wagon, would be twenty-one dollars, while the same journey would require three days for the horse wagons, at a total cost of forty dollars. The cost of repairs he estimates as about the same for each wagon, say two dollars, and hence five times as much for the horse wagons as for the steam wagons.

Apart from the interest which attaches to an estimate of this nature made so very early in the history of steam traction, it is most curious to note, as Mr. Morris points out, that the figures of Oliver Evans in 1804 agree proportionately almost exactly with those determined by experience at the present time.

In general terms, given suitable roads, twice as much work can be done for the same cost with mechanical traction as with horse power. Evans was far ahead of his time in this matter as in some other, and it is a satisfaction at this time to be able to bring to notice his clear grasp of the subject.

* * *

In the days of upheaval of cities, and borings of tunnels, and general rearrangement of local transport, the announcement that Mr Charles T. Yerkes is to enter the field in London with a new underground railway scheme is of both commercial and engineering interest.

The success of the London Central Railway has undoubtedly been the inspiration of this new move, and whatever the outcome, it cannot but attract attention and invite discussion. The name of Yerkes has hitherto been associated entirely with surface traction, and that, too, in America; but the success which has stamped his administration in Chicago gives assurance that, should the proposed scheme be undertaken in London, it will be carried through with energy to success.

Although it is too soon to discuss details of construction and methods of operation, it is sufficient to know that the name of Sir Douglas Fox is given as that of the engineer to warrant confidence in the construction work, while the fact that the electrical equipment and rolling stock will be American will not bring adverse comment.

REVIEW OF THE BRITISH PRESS

Electrical Power Distribution.

THE consideration of the bills recently brought before the parliamentary commission presided over by Sir James Kitson, has called forth numerous communications to the scientific press, and among these one of the most noteworthy is that of Professor Ayrton, in a recent issue of *Nature*.

Twenty-one years ago Professor Ayrton himself used these prophetic words: "If a workman could have transmitted to him, just at the time he might require it, a small amount of energy at, say, one-half penny per hour per horse-power—which would be three or four times the actual cost of production with a very large steam engine—and if he could turn off the power like gas when he did not want it, how many of the smaller workmen of Sheffield would be glad to avail themselves of such a facility!"

To-day the question is not whether this is possible, but rather whether the men who are ready and desirous of providing just such a desired distribution of power are to be permitted to do it.

Professor Ayrton reviews at some length the testimony for and against the four important bills, namely, those for Durham, Tyneside, Lancashire, and South Wales, and while approving on the whole, of the plans for the generation and distribution of electricity in bulk, he shows that the municipalities are not wholly acting the part of the dog in the manger, but that in some cases their positions are worthily entitled to consideration.

On the question of the desirability of central generating stations and electric distribution of energy, he has no doubts whatever. After referring to the fact that most articles of commerce may be divided into those which have weight and volume, and those that have not, Professor Ayrton proceeds:

"But there remains one commodity which, although it has neither weight, volume, nor linear dimension, can be metered with extreme accuracy, and the public demand for which is daily becoming greater and greater, and that is—energy. Hitherto the working of factories has been associated with water and coal, and either the factories have been built near the stream or in a coal region. When, however, such a site could not be conveniently found, then it has been the custom to carry at a dear rate a black, bulky, dirty substance, by rail or water, for miles to the factory, and, after strewing a certain portion of its dirt over the neighbourhood in the form of a descending cloud, to cart the remainder away as dusty ashes."

Of the desirability of replacing this dirty and inconvenient system by central stations and electrical transmission there can be no doubt, but how about the commercial economy? "Is it cheaper to burn the coal at the pit's mouth, and to convey the energy electrically to each of many machines situated within a radius of, say, ten miles from the electric generating center, or to load the coal on railway trucks, carry it in different directions to many factories, unload, stoke the furnaces at many places, and distribute the energy from the many steam engines by shafting, belting, rope-gearing, compressed air, or an electric current generated at the individual factory?"

The question of the cost of transmission depends mainly upon the limit of pressure permitted in the conductors, and while in America electrical pressures of 40,000 volts are allowed, the Board of Trade in Great Britain allows nothing higher than 11,000 volts, and the promoters of the four power bills above mentioned do not contemplate using more than 10,000 volts. With this pressure, however, the cost of underground cable was shown to be about £1,400 per mile, not a prohibitory figure. A second question affecting the selling price of energy is that of the relative constancy of the load factor. In the case of electric lighting the maximum demand exists during a small

fraction of the twenty-four hours of the day, and a far larger equipment is required at the station than if the demand was distributed more equably over the day. If the same plant is employed to supply light by night and energy by day the load factor is more nearly equalised, and it has been estimated that under such circumstances current could be sold to the consumer at 1¼ pence per Board of Trade unit at a fair profit, instead of the 4 pence or 6 pence now charged.

The conditions under which the new enterprises will probably be undertaken were fully set forth in these columns last month, and while there may be some delays and discussions as to what constitute reasonable prices and reasonable times, we may expect to see a beginning of electric power distribution in Great Britain on a large scale. In many cases the municipalities are already awake to the importance and value of their prerogatives, and in such places there is no need for additional service. The local authorities are now to be put on their mettle. "If you realise," says Sir James Kitson's committee, "what are your duties in providing all your people with an ample supply of electrical energy for all purposes, we will be no parties to any hindrance through competition being put in your way. But if your district be one in which Bumbledom reigns supreme, then our declaration is that no municipal barrier shall be left standing to oppose the free entrance of those who come with offers of cheap electric energy."

The Fouling of Ships.

With all the efforts which have been expended to attain speed and economy in the propulsion of ships there has been comparatively little progress made in the important matter of maintaining clean hulls. This bears such a close relation to speed, and hence to power, that it demands the attention of shipbuilders and ship-owners everywhere, and hence the paper of Mr. W. H. Atherton, recently presented before the North-East Coast Institution of Engineers and Shipbuilders upon the subject of the fouling of ships is of interest and value.

Mr. Atherton first examines the conditions under which fouling takes place; all being understood to occur in sea water. The favourable conditions are as follows: Lying at anchor in shallow water; roughness of ship's bottom; high temperature, such as in tropical waters; local circumstances, certain ports appearing to be especially active with fouling germs. These are all circumstances which favour rapid fouling, but it goes on to a greater or less rapid extent in all salt water, and so is a matter of concern everywhere.

The principal effect of fouling of a ship is an enormous increase of the resistance experienced by the ship in its passage through the water; causing a loss of speed, and also in the case of a steamship, great waste of coal, By fouling, the coefficient of friction is quite commonly doubled; and ships occasionally become so foul that the skin friction mounts up to four times its value for a clean bottom.

The effect of fouling is very clearly shown by the comparative speed curves for the same ship with clean and with foul bottom. When it is understood that the power varies approximately as the cube of the speed, it will be seen what a waste is involved. Taking the case of a vessel capable of making 12 knots with 2,000 h. p., when clean, at 80 revolutions, she may be able to make only 9 knots when foul, this requiring about 1,500 h. p. Since the power required to drive the ship at 9 knots, when clean, will be only about 844 h. p., there is 44 per cent. wasted in overcoming the extra resistance.

The best remedy, and indeed the only real remedy, against fouling is copper sheathing. This was extensively used upon wooden ships before the advent of iron and steel construction, but in the latter case a new difficulty appears in the form of galvanic action between the copper and the iron, and consequent corrosion and destruction of the iron. The only manner in which this action can be prevented is to insulate the copper from the hull by an intermediate wood backing, this adding greatly to the expense. Attempts to electro-plate the copper directly upon the plates of the ship have been found objectionable because of this corrosion, and although it has been found entirely practicable to coat the hull with a continuous shell of copper, the excessive corrosion of the steel makes this method valueless.

When a copper sheathing is properly in-

sulated it certainly prevents, to a great extent, the fouling of a hull, but there are various theories as to the manner in which it acts. The most reasonable explanation lies in the fact that copper exfoliates, or oxidises in thin parallel layers, and these very thin layers are gradually shed off, and with them come the animal or vegetable substances which have attached themselves. The chemical, or dissolving theory, which is often confused with the preceding, assumes that there is a continuous formation of a soluble oxychloride of copper which washes off, carrying with it any fouling growths. Besides these there is the biological theory, which assumes that the formation of poisonous salts of copper kills the lower animal and vegetable growths, and prevents their adherence. No one of these theories has been positively demonstrated or disproved, and while the weight of opinion inclines toward the exfoliation theory, it is highly probable that all three actions take place in a greater or lesser degree at the same time.

Zinc has been suggested as an anti-fouling sheathing, and it possesses the great advantage of being electro-positive to iron, therefore protecting the latter from corrosion. The zinc, however, is very rapidly corroded itself, and becomes very rough, unless it is insulated from the iron, in which case it lasts much longer, but is proportionally less effective as an anti-fouler.

The high cost of copper sheathing has caused many attempts to be made to find a satisfactory substitute, and by far the greater number of vessels depend for protection upon some kind of anti-fouling paint or composition. Such compositions, while not as effective as copper, serve their purpose fairly well, the vessels being docked and repainted once or twice a year. From the composition of these coatings it appears that the poisoning theory is mainly held by their compounders, since the principal ingredients are a solution of gum, shellac, or resin in spirits of wine, naphtha, or other solvent, to which, in addition to a colouring pigment, there is added a salt of copper, zinc, arsenic, or mercury. The varnish or other medium is purposely made so as to be slowly soluble in sea water, allowing the action of the contained salts to progress gradually for about a year.

The value of such coatings depends largely upon the manner in which they are applied, and care should be taken to have the hull well cleaned and painted with a rust preventive. The anti-fouling composition should be applied in one coat and kept well mixed, to prevent the metallic salts from separating out, if the best results are to be secured.

The whole subject is one which would well repay a systematic and scientific investigation, and Mr. Atherton suggests that such a study should be made by a special commission, no one man being fully qualified for the task.

Boilers in the British Navy.

At last there is some possibility of definite information about the status of the water-tube boiler in the British Navy, and the many conflicting reports about the Belleville and other forms of steam generator should soon be superseded by definite data from which the engineer and even the layman may draw intelligible conclusions. This state of affairs is due to the fact that the whole matter has been referred to a special committee, with most comprehensive and liberal instructions as to the scope of the inquiry, and the result should be a most instructive and valuable report. From editorials in *Engineering* and *The Engineer* a general review of the composition and work of the committee is possible.

The selection of suitable men for the task was in itself a difficult matter, since nearly everyone possessed of the knowledge and experience is also apt to be interested in some of the types of boiler under discussion. Many prominent marine engineers have also expressed strong opinions upon questions at issue, and are to a certain extent committed to the support of those opinions, and for such reasons many men otherwise well adapted for the work have been considered unavailable. In spite of these difficulties a very strong and competent committee has been appointed. The chairman, Vice-Admiral Sir Compton Domville, has commanded fleets in which the ships have been equipped with cylindrical and with water-tube boilers. The remaining members of the committee are: Mr. List, the superintending engineer of the Castle Company; Mr. Bain, the superintending engineer of the

Cunard Line; Mr. Milton, chief engineer-surveyor of Lloyd's Registry of Shipping, who sat on the former Admiralty Committee on Boilers in 1892; Professor Kennedy; Mr. John Inglis, of the well-known Glasgow shipbuilding firm; and Mr. J. R. Smith, inspector of machinery.

The breadth of scope of the work of the committee is indicated in the instructions, which, while primarily stating is to be "to ascertain practically and experimentally the relative advantages and disadvantages of the Belleville boiler for naval purposes as compared with the cylindrical boiler," also to investigate the causes of the defects which have appeared in the Belleville boilers in the service, in order to find out to what extent they have been due to the system.

In addition to the comparison of the Belleville and the shell boilers, the committee is authorized to report on the advantages and disadvantages of the Babcock & Wilcox and the Niclausse boilers as compared with the Belleville, and also to report whether any other description of boiler is advisable for use in any of Her Majesty's ships. This important feature in the instructions permits the discussion of the suitability of the small-tube types which have come into such general use for torpedo boats and destroyers, but which have not yet been employed in any large cruisers and battleships.

A number of practical experiments will doubtless be made, since the Hyacinth, a cruiser with Belleville boilers, and a similar cruiser with cylindrical boilers, are to be placed at the disposal of the committee. All the reports which have been made upon the defects of machinery and boilers during the naval manœuvres will be at the service of the committee, and especial facilities given for making runs on ships in commission and examinations of boilers and machinery while in port. Any points thus brought out which may need further study will be supplemented by special experiments, and it certainly appears as if the desire to get at the real facts in an official manner is to be gratified.

Apart from the value of the work of this committee to the Admiralty, it should be most useful to steam engineers generally, since it must practically result in a complete treatise on marine-boiler construction. Possibly it may also be the cause of the evolution of some improved form of marine water-tube boiler better adapted for the service than any now in use; the results of experience certainly should offer opportunity to suggest numerous improvements.

It is to be hoped that the work of the committee will be pushed forward with all possible dispatch, not only for the welfare of the navy, but also because of the great general value of the information to the engineering profession everywhere.

American Coal in England.

THE much-talked possibility of American coal entering the English market, as a consequence of the rise in price, came to a concrete example by the arrival in London of a consignment of 3,700 tons from Philadelphia for the South Metropolitan Gas Company. The quantity itself is insignificant, but the fact is something for thoughtful examination.

A communication in the *Journal of Gas Lighting* discusses some points bearing upon the present situation which are interesting. The character of the coal was special, being the Westmoreland gas-coal, claimed to have a productive capacity 40 per cent. higher than ordinary English gas-making coal.

At the present time the cost of transport renders this American coal somewhat higher than English coal, but if experience supports the claim for the higher gas production it will be cheaper in the end, and the ostensible object of the importation is to ascertain the real quality of the coal. At the same time there is little doubt that the ultimate effect of the entrance of American coal into English markets will be to check the advance in prices by providing a competing supply whenever the limit is reached, and there is little doubt that this and other proposed importations are expected to be an object lesson to the British coal trade.

There can be no doubt whatever that the American coal operators are planning for a European market, and even if large direct shipments are not made to England, the export of coal from England to various parts of the continent may be checked by the entrance of the American product. Two main factors may be expected to influence the question. One is the question of transport, as it is in this that the controlling element

in price exists. Lines of colliers must be established, vessels chartered or built, and all the machinery for economical transport provided. This takes time, and money, and it is not to be expected that commercial enterprises of such magnitude will be undertaken without assurance that the advanced price of coal is to be maintained. The second factor is therefore the question of the stability of the market.

While the present prices are doubtless due to a combination of causes, and it is not to be expected that they will be uniformly maintained, yet it must not be forgotten that the demand is a constantly increasing one, and that almost daily new applications for power, demanding almost invariably more coal, are made. Higher speeds on railways and steamships add to the drain, while the demands for lighting and for electric traction are clear additions to the older manufacturing interests. In spite of fluctuations, therefore, the general tendency must continue upward unless foreign supplies act to check the pressure.

Several results may be expected to flow from the rise in coal, among them being an increased demand for fuel saving devices, or rather more attention paid to the arrangement and design of plant with a view to fuel economy. Many a steam engine is running to-day at a fuel cost on which a possible economy would offset the increased price of the coal, while the use of inferior fuels in gas producers for gas engine supply opens up a wide field for fuel economy. In similar line comes the utilisation of furnace gases, now wasted, but fully capable of being utilised for power to be distributed, not only throughout the works itself, but to outside subscribers. These and many other similar ideas will be developed just as soon as the pressure of increased coal prices shows them to be profitable, and thus there are other methods besides that of importing American coal.

The Reorganisation of Machine Works.

It is always easier to start right than it is to correct mistakes after they have taken root, and this is especially true in connection with industrial and manufacturing establishments. Just at the present time there is more or less agitation about the antiquated plant and methods of British machine shops, and while much of the talk is idle and unfounded, yet there is undoubtedly room for improvement in many instances.

The whole subject of the task of reorganisation is discussed in a recent editorial in *Engineering*, with so many remarks that are pertinent to the present situation that a review is most appropriate.

That reorganisation is in many cases imperative, if supremacy is to be retained, must be admitted. Change is continually going on without, and in spite of monopolies in patronage, ownership of patents, control of methods, etc., competition of improved methods in the hands of energetic rivals will not permit success to exist without progress. The competition which has existed in the past, and that of the immediate present, is only a foretaste of what may be expected, and there can be little reasonable doubt that the next generation will witness changes of which but few have yet any adequate conception. "It is not in one branch of engineering alone that these changes may be expected to take place, but in most, or in all. They will affect each section of manufacture vitally, and firms who cannot become adapted to change will fall out of the running."

Three main factors enter into the problem of reorganisation: design, methods, and men. These are considered in detail in the article to which reference has been made, but can only be glanced at here. In regard to new designs it is very possible to confound change with improvement, and while it is a mistaken conservatism which clings to old machines simply because they are tried old friends, it is a wise progress which anticipates improvement along the true lines of progress. The sage dictum of the old politician may well be remembered: "Find out which way the procession is going, and get in front."

The question of men is, and always will be, a difficult one. The training of the machinist is necessarily a narrow one, although much of this depends upon the man himself. New products, new methods necessarily involve the abandoning much that formerly constituted part of the trade, and when the workman sees what was a fundamental portion of his capital, his personal skill, becoming obsolete, he naturally feels that he should struggle to retain his

specialty. Here again the wise workman must follow the same lines as the wise employer, and endeavour to place himself in the forefront of the advancing procession, for he may be very sure he cannot permanently stay its progress, nor should he wish to if he could, since his own advancement is bound up with it.

But it is with the reorganisation of shop methods that the manufacturer is at present most directly concerned, and here, too, it is a mistake to undertake everything at one time.

"A firm may introduce new designs, have a tractable set of men, or have introduced much new blood, and yet it may fail in consequence of not possessing correct views relative to the best methods of carrying out its ideals. There may be the newest and best machinery without the knowledge of how best to take advantage of its capabilities; or machinery may be laid down suitable for the performance of one class of manufacture, but quite unfit for the work of the firm in question. Here, therefore, in reference to the methods of doing work, it is easy to err through ignorance, or want of clear-sightedness as to the conditions of manufacture. Bad work can be turned out on the best machines, slow work on the high-speeded machines; and operations may be done on machines for which they are not so well adapted as others. Money may be wasted on templets for which there is no need; and expensive plant may be laid down for doing a class of work that could be more economically done by other means. Some firms with plenty of money manage to go in the most uneconomical ways about their work, while others with little surplus capital or space, contrive to produce better results at comparatively slight expense. Many illustrations of these facts will occur to the mind, but it is sufficient to state them merely."

One of the first points where reforms may well be instituted is in the tool room, and very much more may be got out of old machines under a good system emanating from the tool room than some people would suppose. This portion of the works is especially adapted for instituting the reform of removing the care of tools from the hands of the workman and intrusting them to specialists, and paves the way for the division of the workmen into skilled tool makers and comparatively unskilled machine tenders, an arrangement absolutely essential if full capacity is to be obtained from modern automatic tools.

As designs are modified repetitive processes may be introduced, and this naturally paves the way for piece-work prices and for a rigid store system based on a division of tasks. These may well be followed by the separation of the establishment into distinct departments, each having its systematic dealings with the others, and each held responsible for its own income and outgo. By following some such gradual and careful development success is much more likely to be attained than if a radical change be made all at once, and, although the whole scheme for reorganisation may be clearly formulated in the mind of the chief, it may well be installed gradually with much greater probability of success than if greater haste be attempted.

Gaseous Fuel.

THE advantages of gaseous over solid fuel have long been recognised, at least for a number of applications, and on the score of convenience, cleanliness, and wide adaptability no arguments are needed to enforce its claims. In the United States the numerous applications of natural gas are well known, and notwithstanding the somewhat diminished supply, still very extensive.

The applications of producer gas have been extensive in certain directions, and at the present time the use of blast furnace gases is not only a matter for discussion, but of realisation.

With the development of improvements in the production of water gas, wider applications of gaseous fuel must be expected, and in this connection the paper of Captain C. C. Longridge, in a recent issue of *The Engineer*, is most suggestive.

Water-gas, being practically all combustible, hydrogen and carbon monoxide, is eminently adapted for metallurgical operations, and has already found most successful applications in connection with reverberatory or open-hearth furnaces. Captain Longridge, however, suggests its use in place of solid fuel in blast furnaces, and makes out a very good case in its favour.

Although he advocates the use of water-

gas for iron furnaces, he discusses first the somewhat smaller problem of lead furnaces.

Commencing by an analysis of the reactions which occur in connection with solid fuel, Captain Longridge shows that the ordinary furnace must be so shaped and fired that carbon monoxide shall be formed at the proper point in order that the desired reducing effect may be produced. The action of such a furnace depends upon many factors, such as height of column of charge, shape of tuyere zone, area of tuyeres, volume and pressure of blast, and manner of charging the ore, these acting to regulate the manner of the formation of carbon monoxide. With the use of water-gas, however, the necessity for these regulating factors vanishes, because the carbon monoxide is produced outside of the furnace, and the whole problem is reduced to the regulation of the respective quantities of gas and air admitted.

"But water-gas has other advantages. One of these is the ease with which the fuel is burnt exactly where it is required, and the fusion zone is circumscribed within the desired limits. Where solid fuel is disseminated with the charge throughout the furnace, any irregularity of the blast, etc., may cause the combustion to creep upward, burning the fuel where it is not only useless, but absolutely prejudicial to the proper running of the furnace. With water-gas this is impossible, for the charge contains no fuel.

"A further advantage is the cleanness of the fuel. Water gas is not only easily purified from sulphur, which for iron and steel smelting, is of importance; but it is free from ash, which, for every kind of smelting, is an undoubted benefit."

While there are no absolute facts upon which the important question of economy can be determined, yet water gas made by a modern process, such as the Dellwik-Fleischer, should show a decided advantage over coke. The gas itself represents the possible utilisation of 80 per cent. of the calorific value of the fuel; it can be stored without deterioration; it can be applied without waste, and with almost theoretically perfect combustion; it involves no labour in charging; it admits of easy furnace regulation and safe running; and, owing to the absence of dust and ash, it increases the output, and probably lessens the wear and tear of the furnace. Besides these notable differences, the water gas supplies, on an average, about 51 per cent. of hydrogen, which, acting as a reducing agent, should tend largely to augment the furnace capacity.

There are, undoubtedly, certain difficulties attending the use of gaseous fuel in high furnaces. One of the most important of these, affecting also the use of oil fuel and of charcoal, is the inability of such fuel to support a heavy ore burden. This difficulty is properly avoided by a different construction of furnace. Since the customary sequence of reactions is not required in using a fuel separately generated, a high ore column and heavy ore burden are not required. With fairly coarse ore, or with bricked fine ore, a furnace of modern height and width, and possibly a double or treble tier of gas inlets, no difficulty should be experienced.

Taking into account the experience which has been had with water-gas as a fuel for open-hearth furnaces, there seems to be every reason that, with the more economical methods of generating the gas, it may come to be an important factor, even in iron smelting, while for smaller furnaces for lead, antimony, etc., its success seems to be assured.

The Machinery of Fighting Ships.

In commenting editorially upon a recent paper by Rear Admiral Melville, U. S. N., the *Engineer* discusses some of the characteristic requirements of the propelling machinery of warships as compared with vessels of the merchant marine, and brings out some useful points.

In an Atlantic liner, or any other high class merchant vessel, conditions are so nearly uniform that it is possible to accomplish the required result within a close degree of satisfaction. The engines are designed to work at the pressure which suits them best, quite irrespective of size, and they are always worked as far as possible at the same speed and pressure, that speed and pressure being the best possible.

In a warship, by far the greater part of the service rendered by the engines is to propel the ship at a cruising speed far below that which may be called for in time

of emergency. This means that with the usual construction the engines must be either far too large for their cruising capacity or much too small for economical performance at full speed. If an engine is underloaded the losses by cylinder condensation and internal friction are disproportionately great, while, if it is overloaded, the mean pressure becomes far too high for economical working.

"The best that can be done is to effect a compromise. The engines are designed to give the best results at some moderate cruising speed. For lower speeds they are too large; for higher speeds they are too small; and the further we depart from the best speed the worse are the results. For this reason it is most unfair to compare the performance of a fighting ship with that of an Atlantic liner. The fighting ship could only compete in economy with the liner if she was invariably run at one speed. In the case of the liner her most economical speed is also the fastest speed. If it is not, then her engines are too small. We may safely say that they are never too large. The engines of the warship do not work to the best advantage at full power."

The solution of the problem, according to Admiral Melville, is the use of triple screws, with three independent engines, and it is this treatment of the problem that the *Engineer* examines.

Those warships which have thus far been constructed with three propellers have had the power equally divided between them, but the present proposition is to make the wing engines of about half the power of the centre engine, thus giving either a twin-screw combination or a single screw of equal power, or the full combination of double the power. Comparing the triple screws with twin-screw propulsion, it is safe to assume that with two ships of the same shape, displacement, and horse power, the economy at full power would be identical, while a part power for cruising the triple system permits the central engine to be thrown entirely out of service, while the wing engines may still be maintained at their economical power.

If this plan is not desired there are others which may be employed. Thus, with twin screws two sets of engines may be provided for each screw, the forward set being disconnected when cruising, but this plan showed its defects at Santiago, when some of the swiftest vessels in the United States fleet were unable to use full power in great emergency, owing to the time required for coupling up the disconnected engines. Another system is to provide for various combinations of the cylinders of each engine, so that the low-pressure cylinder of a triple-expansion engine may be shut off, the high and intermediate cylinders being worked compound for cruising. Up to the present time, however, the triple screw system appears to offer the greatest advantages. Apart from the possible subdivision of power, it permits repairs and adjustments to be made on the standing engines without interfering in any way with the operation of the others, and while a distinct economy in fuel has not yet been proven, it is equally true that no loss has been shown.

REVIEW OF THE CONTINENTAL PRESS

The Paris Metropolitan Railway.

WITH the starting of the first completed portion of the Paris underground electric railway attention has been called to the magnitude of the whole scheme proposed, and in a recent issue of *Le Génie Civil* the plans of the completed and projected portions are examined, with many illustrations of the work in progress.

The fraction of the underground railway at present completed and in operation extends clear across Paris from east to west, from the Porte de Vincennes to the Porte Dauphine, passing beneath the Bastille, Palais Royal, Champs Elysées, and Place de l'Etoile. This is known as Section A; the portions remaining to be built are as follows: Section B, a belt line, following the circuit of the old exterior boulevards; Section C, connecting the two previous portions on the north, from the Porte Maillot to Ménilmontant; Section D, the north and south transversal line, from the Porte de Clignancourt to the Porte d'Orleans; Section E, connecting the Boulevard de Strasbourg with the Austerlitz bridge; and Section F, connecting the Cour de Vincennes with the Place d'Italie. The extent of this work may be understood when it is stated that the portion already completed is only between one-fourth and one-fifth of the entire length, the whole amounting to about 40 miles. About 70 per cent. of this is entirely underground, while 16 per cent. is viaduct and 14 per cent. is cutting.

A general description of the work and the routes cannot give any adequate idea of the difficulties encountered, but it must be remembered that underground Paris is threaded with sewers, subways, and obstacles, and that in many instances an entire rearrangement of previous underground work was involved. In all cases the operating line is made double track, single tracks being used only where special connections have been provided between separate sections.

Without going into the details of the stations of the part now in use, some of the special points about them may be mentioned.

The terminal stations are of the loop, or racquet form, with the arriving and departing platforms on opposite sides, while the way stations are arranged with platforms on each side and a bridge or passerelle, to enable communication to be made across without crossing the tracks. At the Lyons Railway Station the Metropolitan is made with a so-called double station, this occupying a large space covered with a metallic platform, and being intended for use with a section of the belt line yet to be built, as well as for the present operative section. At the Place de l'Etoile, under the great triumphal arch, was some especially difficult work, since, besides approaching perilously close to the foundations of the great monument, the two sections of the road there cross, the one passing beneath the other.

The road is constructed with rails of the Vignoles section, of 52 kilogrammes per metre weight, the rails being 15 metres long, and carried on creosoted wooden cross-ties. The conductor-rails are carried by the side of the main lines upon insulators, and the return current passes through the track rails, which are effectively bonded together at the joints by four copper conductors.

The article referred to gives much interesting information about the construction of various sections of the work, which was divided up among a number of contracts. In some portions the tunnelling was accomplished by aid of the shield, in others the cutting was made open to the surface, and filled in after the arch or girder roof had been constructed.

Each train is composed of one motor car and two trailers, the motor car also containing places for passengers. The motors are of the Westinghouse type, there being

two of 100 h. p. each, on each motor car. These were constructed by the Société Industrielle d'Electricité at Havre. The motors are connected in series and for some seconds are capable of developing double their rated power. The authorized speed of trains is 36 kilometers per hour (about 22 miles) but the actual speed is 25 to 30 kilometers (15 to 18 miles) permitting the run from the Porte de Vincennes to the Porte Maillot to be made in half-an-hour, including stops.

Although the reports which have been made as to the actual working of the Metropolitan have not shown it to be rendering the relief to the congestion which was hoped, yet it is but natural that some time should be required for all to get in smooth working order. The fact that the present portion is but a fraction of the entire plan also renders it sufficiently incomplete to give it less efficiency than would otherwise be the case. At the same time it is to be welcomed, as is also the companion road in London, as the beginning of a transfer of the through traffic of great cities from the surface to underground ways, permitting growth without excessive congestion of streets and enabling time to be spent in useful and satisfactory occupation, instead of wasting it in a wild scramble to and from the scenes of activity.

Petroleum Fuel in Metallurgy.

THE disadvantages of solid fuel are now very generally recognized, and in another column we have discussed the desirability of using gaseous fuel for metallurgical operations. In many cases, however, it is desirable to use liquid fuel, without the intermediate stage of conversion into gas, and in this connection the paper of M. G. de Krivochapkine in a recent issue of *Le Génie Civil,* will be of interest.

In Russia, where petroleum is readily available as a fuel, there has naturally been attempted various methods of utilizing it to the best advantage, especially by the firm of Nobel Brothers, by whom the petroleum industry has been so extensively developed. As long ago as 1882 M. Nobel presented several communications to the Russian Imperial Technical Society at Moscow, and made the experimental demonstration of the fusion of a ton of cast iron by the combustion of 66 kilogrammes of petroleum residue.

The principal innovation made by Nobel was the special form of grate upon which the petroleum residue was burned. This arrangement consists of a series of superposed troughs, placed at the entrance of the furnace, the liquid combustible being allowed to flow into them under the control of a device by which a constant level is maintained. A space is provided between each trough for the admission of air, and when the fuel is ignited the draft of air over the troughs maintains a complete combustion without requiring the use of steam jets or compressed air, thus giving a marked advantage over similar devices. The stream of burning gases from this device may be employed in a variety of ways. It may be directed over a series of crucibles for melting steel, in which case experiment has shown that 0.6 ton of petroleum residue has sufficed to melt a ton of steel, as compared with the combustion of 1.5 tons of coal.

For the evaporation of water it has been customary to use the steam atomizer, but with the Nobel system it has been shown that 14.35 litres of water have been evaporated per kilogramme of residue, as compared with 11.4 litres with the use of the atomizer. At St. Petersburg and in the Caucasus this arrangement has been used in connection with the reverberatory furnace for the fusion of copper in crucibles. The general arrangement does not differ greatly from the ordinary reverberatory furnace, the petroleum burners being placed in the position of the furnace door, and the grate being covered. The flame from the burning petroleum then streams over the bridge wall upon the hearth, and with the proper admixture of air, produces an intense heat. The use of petroleum residue is of especial importance in this connection in the Caucasus, in which wood and coal are almost entirely lacking, and numerous industries have grown up in the Baku region, depending upon petroleum residue as fuel.

Another application of petroleum as fuel is found in the so-called Quarnström furnace. This is a form of portable petroleum forge, especially adapted for heating rivets. In this furnace the troughs containing the

petroleum are placed at the bottom, with air spaces between, supplied by the natural draft. This furnace appears to work very well, but in order to avoid the production of too much soot it has been found best to employ the lighter hydrocarbons, instead of the petroleum residue.

An important application of the petroleum furnace has been in connection with glass works, in which the Kroupsky regenerator has been employed to advantage. In this case the furnace is provided with regenerators similar to the Siemens regenerative furnace for gaseous fuel, but instead of using the chambers of highly heated brick checker-work to heat the incoming air, they are employed to gasify the petroleum vapour, and thus render its combustion more complete and intense.

In connection with the manufacture of glass the Malichef furnace has also been employed, this more nearly resembling the ordinary Siemens regenerative furnace. Here the vapour of petroleum and the air both pass through the regenerative chambers, and are thus prepared for most complete combustion. It is asserted that in these furnaces 1.3 tons of petroleum residue will melt 4 tons of glass.

These illustrations show that Russia is making active progress in the utilisation of petroleum as fuel, and that possibly other parts of the world may have some lessons to learn from her.

The Port of Bilbao.

In view of the present interest experienced in the development and export of Spanish iron ores to England and other parts of the world, the paper of M. L. Coiseau, recently presented before the Société des Ingénieurs Civils de France, and published in the *Memoirs et Comptes Rendus* of that society, demands notice and review.

Bilbao is one of the most important mineral centres of Spain, the excavation of iron ore amounting to nearly 6,000,000 metric tons per year. As a natural consequence there are also numerous other industries, including blast furnaces, steel and iron works, rolling mills, tube mills, and other manufacturing establishments extending along the banks of the Nervion. As the iron mines are open workings there are no especial methods demanding attention. Transportation devices of all sorts, from the mediæval ox-cart to the modern aerial cableway are in use, as well as railways, inclined planes, and cable traction.

The Port of Bilbao, at the mouth of the river, through which practically all this traffic must pass, has long been the object of attention. Since 1878 the tonnage of the port has risen from 1,340,000 to more than 5,000,000 tons, of which 4,800,000 tons consist of iron ore, thus rendering the port not only the most important of the Spanish Peninsula, but also one of the most important of the continent of Europe. Under these circumstances it is not surprising that every effort has been made to create and maintain a satisfactory waterway in the river, as well as suitable harbor improvements at the port.

The first portion of the work was that of the improvement of the river. Down to 1878 the stream flowed over an irregular bed, with sharp bends and numerous shoals, rendering navigation impossible for boats drawing more than 10 to 12 feet of water. The mouth was obstructed by a bar, and the tide varied from 15 feet in the equinoctial season to a minimum of 4 feet, the yearly mean tide being 11.8 feet.

The work was commenced by the regulation of the channel in the river. The sharp bends were replaced by curves of longer radius, dikes were built to contract the channel at the excessively wide portions, and dredging was resorted to to remove the shoals. At the present time there is a depth of 13 feet from the mouth of the river up to the city of Bilbao at low tide.

A study of the bar at the mouth of the river showed a tendency of the currents to transport sand from the east to the west side of the entrance, while the action of the north-east gales reversed this effect. The engineer, M. de Churruca, came to the conclusion that the deposit could be prevented by a proper breakwater construction, and that under such circumstances a channel produced by dredging could be maintained.

The works included the construction of a mole or jetty carrying the left bank of the river, by the town of Portugalete, out into the bay, thus conserving the force of the current beyond the point when the sand might deposit; a slight curve directing the flow against the opposing outer current.

Beyond this jetty two breakwaters had already been constructed, enclosing the inner harbor, acting to break the force of the waves in rough weather, and provide a safe place for vessels entering the harbor and awaiting entrance to the river.

A large portion of the paper of M. Coiseau is devoted to the construction of the jetty at the mouth of the river, this important piece of work being 2,600 feet in length, extending beyond the extremity of the bar into a depth of 23 feet of water. The foundation of this jetty, from the bottom up to low water, is composed of loose rock, no piece being less than one ton in weight. The first 1,800 feet of the jetty is composed of screw piles carrying a framed truss work of which the top is 25 feet above low water. Between the piles, and resting upon the rockwork below, is a solid concrete filling, to guide the currents produced by the tides, and thus aid in scouring out the channel. The action of the waves was too strong to permit this construction to be used for the outer portion of the jetty, and hence a filling of concrete was worked into the rock foundation and upon this was erected a solid superstructure of large blocks of artificial stone. At the outer extremity the jetty is 13 feet thick, and the foundation is also much enlarged, in order the better to resist the powerful action of the waves.

These works were finished in 1890, and since that time the channel has steadily deepened, so that there is now a channel of 6½ feet deep for a width of 250 feet, while along the line of the jetty there is a depth of 16½ feet, decidedly more than had been hoped for.

As a result of this success, vessels of 20 to 22 feet draught can now enter at high tide, where formerly boats of 12 to 13 feet draught hardly dared venture, and the tonnage of the port, as already stated, has risen from 1,340,000 in 1878 to 5,800,000 in 1896.

The especial importance of this improvement at the present time lies in the dependence of England upon Spain for much of her iron ore, and indeed it is to the rich beds of the Spanish Peninsula that England looks to enable her to compete with the Minnesota supplies which have done so much to develop American iron production. With iron, as with coal, the question of transport may yet become the controlling one, and intimately connected with this is that of harbor and terminal improvement, of which this example of Bilbao is such a striking instance.

The Baltic-Caspian Canal.

ALTHOUGH it is generally understood that the internal waterways of Russia are of great extent and importance, yet from an engineering standpoint they have not been examined as their importance demands, and hence the report of MM. Suquet and Fontaine, published in a recent issue of the *Annales des Ponts et Chaussées*, is of especial interest. These two engineers, having been commissioned by the French Department of Public Works, and aided by the cordial co-operation of General Petroff, of the Russian Ministry of Ways and Communication, have made a thorough examination of the waterway from St. Petersburg to the mouth of the Volga, a distance of more than 2,500 miles.

Although we have referred above to the system as a canal, it is really composed of rivers, partly canalised, and of short portions of canals, forming a mixed system of waterways, of which the greater portion consists of the river Volga. This great river, which has its rise in the Valdai plateau, only about 125 miles from St. Petersburg, after being fed by a number of important affluents, empties into the Caspian Sea, after a course of 2,200 miles. With the rivers and canals which connect it with St. Petersburg, it forms the longest navigable waterway in Europe, and during the seven months in which it remains free from ice the traffic attains 5,000,000 tons.

In describing this important waterway it may be divided into two sections; the first, called the "Système Marie," about 700 miles long, including the canals and canalised rivers between St. Petersburg and the Volga, and the second, the Volga itself.

From St. Petersburg to the Volga the waterway traverses the Neva, the lakes Ladoga and Onega, the river Vytegra and Kovja, lake Bielo, and the river Cheksa. Of these the Neva is well-known, extending as it does from the Gulf of Finland to St. Petersburg, and improved by the Neva canal from Kronstadt to the capital. Passing on to lake Ladoga and the river Svir to lake Onega, the river Vytegra is reached,

and after ascending the rapids, the canal connecting with lake Bielo and the river Cheksna carries the navigation over the divide, into the upper waters of the Volga.

In all this portion of the navigation artificial improvements have been made, extending from the canal of Peter the Great, from the Neva to Volkhof; of Catherine II., from Volkhof to Sias; and the canal of Alexander I. from Sias to Svir, of the earlier improvements, down to the modern works constructed during the reigns of Paul, Alexander II., and Alexander III. Owing to the rough weather on the lakes it has been found necessary to construct canalised ways skirting the banks, and in the preservation of the embankments of these canals is found one of the important problems connected with the maintenance of the communication system.

Another feature of importance is the construction of channels in the rapid currents of the Svir and the Vytegra, as it is in these streams that the ascent is mainly made over the elevation beyond which the head waters of the Volga begin. Here a number of locks are required, and mechanical haulage has also to be used to overcome the current. It is impossible to go into the details of the improvements as they are described in the report, but while some of the works appear more or less primitive, it will be found that they are the result of long experience in the difficult conditions which have to be met, especially in the face of distance from supplies or headquarters.

The boats used upon the waterway are peculiar, and vary according to the character of the burden and the locality from which they come. In many instances they are intended for but a single journey, being taken to pieces and sold for the timber. This is especially the case with the boats going from the timber-working country of the Cheksna and Kovja to St. Petersburg. A special form of boat is used to transport petroleum from the Caspian to St. Petersburg, and as these are 250 to 325 feet long, they are arranged to be divided into two parts in order to permit them to pass through the locks.

When the Volga is reached the navigation becomes more that of a commercial river and less of a canal, although there are numerous artificial improvements and canalisations. Many of the cities have important wharfage facilities, as at Rybinsk, Nijni-Novgorod, Kazan, Tsaritzin, and other points are important commercial centres.

At the delta of the river, where it discharges into the Caspian, the two towns of Petropaulosk and Astrakhan form important trade centres, and since 1845 important improvement works have been conducted.

Lack of space prevents any discussion of the details of the engineering works upon this immense waterway, but the memoir of MM. Suquet and Fontaine gives a scientific account of what has been done and what may be done in the future, and when the dependence of such enormous areas upon engineering works is fully understood it will be seen what the effect will be when such projected works as the canals uniting the Don to the Black sea, and the Siberian waterways are completed.

Wind Pressure.

Some time ago attention was called in these columns to the address of Sir John Wolfe Barry before the British Association, in which he maintained that the usual allowance for wind pressure upon bridges, buildings, and framed structures generally was excessive, and required unnecessarily heavy dimensions. It was then also pointed out that the experience of the hurricane at St. Louis, U. S. A., had demonstrated by the computations of Mr. Julius Baier upon structures overthrown, that the customary allowances were none too great.

We now have an elaborate discussion of the whole subject of wind pressure in a paper by Herr R. Kohfall in the *Zeitschrift des Vereines deutscher Ingenieure*, which examines critically, not only the absolute pressure of the air, but also the manner in which we may reasonably suppose it to act.

For the actual magnitude of the wind pressures, the experiments of Zeppelin are taken, and compared with those of Sir Benjamin Baker upon the Forth Bridge Works. These are also compared with the results obtained by long observations at the Hamburg Seewarte, the official weather observatory of Germany, and the deductions are discussed in a very complete and scientific manner.

In general it is shown that experiments

made upon wind gauges of small area give results which are too high, and that more reliable data are obtained by using surfaces of greater area, this agreeing to a certain extent with the position of Sir John Wolfe Barry.

The measurements, as compared by Herr Kohfall, show that the observed wind pressures, when acting normally to the exposed surfaces, range from 100 to 220 kilograms per square metre, or about 10 to 20 pounds per square foot. This rather agrees with the statement of Sir John Wolfe Barry, in which he maintains that the customary allowance of 56 pounds per square foot is about 60 per cent. too high, and may lead to a modification in engineering practice in this respect. At the same time it must not be forgotten that it is the extreme maximum pressure which must be provided for in the case of all framed structures, and the fact that the pressure increases with the square of the velocity renders caution most necessary. The case of the St. Louis hurricane has already been cited, and the terrible disaster at Galveston has again shown how the fury of the wind can sweep aside whole cities, and it well behooves the engineer to go very cautiously in modifying or reducing his constants of wind pressure. It is most desirable that all possible data should be accumulated on a subject which in many instances is of controlling importance, and the action of wind forces should be discussed as Herr Kohfall has discussed them, for every practicable application and action, but any attempt to reduce their assumed maximum effect should be based, not upon theoretical conclusions, but upon the actual results which have been experienced in various parts of the world. There are numerous instances of well determined structures having been damaged or even overthrown by the action of the wind. The stability of these can be computed within reasonable limits of accuracy, and from these we may determine what the wind really has done in the past, and deduce what it may do in the future.

River Regulation.

THE control of currents, the protection of banks, and the production of satisfactory channels have long formed a branch of civil engineering of importance, but notwithstanding the study which has been given to the subject it is still more or less empirical in actual practice. For this reason the paper of Herr Ignaz Pollak, in a recent issue of the *Zeitschrift des Oesterreichischen Ingenieur und Architekten Vereines,* is of value, since it gives a brief review of past practice, and endeavours to gather experience into some kind of system.

The action of flowing water is not that of direct progress, but is composed of swirling eddies and direct and reverse curves, all of which go to make up the general movement. These movements produce centrifugal and centripetal forces which act upon the banks and bottom of the channel, and are in great degree responsible for the changes which occur.

Herr Pollak refers to the theory of Professor James Thomson, showing the formation of river channels in alluvial soil, and discusses the laboratory experiments conducted by Professor Engels at Dresden, in which the influence of currents upon sand of various sizes were made, in order, if possible, to reproduce the conditions which actually occur. These are compared with the theory of Girardon, which, according to Professor Pollak, comes the nearest to the actual behaviour in observed streams.

Instead of endeavouring to compel the stream to follow a determined channel, it should be regulated or guided so that the channel may be created and maintained by the forces within the flowing water. This natural channel is the one which is followed by the stream at low water, and the curves traced out under this condition may guide in indicating the nature of the regulating works to maintain the course of the stream during high water and in time of flood to control it.

An example of the adoption of this principle in practice is seen in the improvement of the Weser above Bremen, conducted under the direction of Franzius. Here, for a stretch of 900 metres in length, two reverse curves were to be controlled, and by observing the natural action of the water in forming its channel at low water the improvements were designed. Another application of the same principle is found in the work upon the Rhine between Basel and Dettenheim, conducted by Faber.

Herr Pollak brings up the question whether, for commercial purposes, especially internal navigation, it is better to attempt to improve and regulate natural waterways, or to construct entirely new canals. In many instances regulation can be readily effected at a moderate cost, and new waterways would be out of the question, but in others the difficulty of maintaining the natural channel in navigable condition renders it advisable to parallel the stream with a canal and use the river merely as a feeder.

Herr Pollak goes into the whole subject from a broad, general standpoint, and while he admits that each case must be largely decided on its peculiar conditions, yet he shows the great desirability of following the natural laws indicated by the behaviour of the stream itself, rather than any attempt to confine it within a channel, which however convenient it may be, is distinctly opposed to that which it naturally inclines to follow.

The Banki Motor.

An interesting feature of modern mechanical development is the marked attention which is being given to heat motors other than the steam engine, and the remarkable development of various forms of the internal-combustion motors is most interesting. Among the more recent inventions in this line of work we have already noticed the motor designed by Professor Donát Bánki, of Budapest, and now we have very full accounts of its latest performances in recent issues of the *Zeitschrift des Vereines deutscher Ingenieure* and in the *Zeitschrift des Oesterreichen Ingenieur und Architekten Vereines,* from which we make some abstracts.

It is now generally realized that in order to obtain high economy in an internal combustion motor a high compression must be employed. In the ordinary gas or petroleum motor the limit to the compression is attained when the temperature of compression reaches the ignition temperature of the mixture of gas or vapor and air. If this ignition temperature is reached before the end of the compression stroke there will be a premature explosion, the motion will be reversed and the motor will fail to operate satisfactorily.

In the case of the Diesel motor this difficulty is avoided by compressing the air alone, and only injecting the liquid fuel at the moment when the combustion is desired, and this method also utilises the heat of compression as an igniting device.

Professor Bánki adopts another method. The charge of mixed air and hydrocarbon vapour is drawn into the cylinder as usual, but with it is also mingled a fine spray of water. When the high compression is given to this mixture the water absorbs a portion of the heat of compression and thus the temperature may be kept below the ignition point. When the combustion does take place the conversion of the water into steam adds to the expansive power of the charge and thus aids in the power stroke, and at the same time the absorption of heat in the generation of this steam aids in keeping the cylinder from becoming overheated.

In the paper of Professor Meyer, above referred to as appearing in the *Zeitschrift des Vereines deutscher Ingenieure,* the construction of the motor is clearly shown by drawings and sections, and in general it differs but little from an ordinary vertical gas or petroleum motor. The principal addition lies in the device attached to the inlet passage to provide for the admixture of the water spray.

With this arrangement of parts it has been found possible to work with as high a compression as 16.4 kilogrammes per square centimetre (233 pounds per square inch), without causing pre-ignition of the mixed charge, while the pressure of explosion attained is 39 kilogrammes (540 pounds).

In the tests made by Professor Meyer and others, the fuel used was benzine, this being found most satisfactory, and very full data and results are given for a series of trials upon a motor of 20 horse power. The motor was operated at powers ranging from 26 down to 8 brake horse power, and showed a thermal efficiency, on the brake, of 28 per cent. when operating at full load.

When it is understood that this includes the internal resistance of the motor, and that trials showed the mechanical efficiency of the machine to be only 74 per cent., it will be seen that this is an excellent performance, decidedly higher than would have been possible under ordinary conditions. The action of the injected water is

well seen in the diminished proportion of heat rejected in the cooling water of the cylinder jacket. Instead of 40 per cent. of the heat being carried off in the cooling water, as is the case with gas engines of the ordinary construction, the loss in this way ranged from 21 to 27 per cent., thus showing that a large proportion of the heat usually rejected in the jacket was taken up by the water into the cylinder, where it was converted into work.

The idea of injecting water into the cylinder of an internal combustion motor is not entirely new, and Professor Meyer points out the fact that in the early gas engine of Hugon, water injection was used to cool the cylinder. In such an engine, however, there was little or no compression, and the injected water did not act to improve the efficiency of the machine, while in the Bánki motor the action has been combined with the use of high compression in such a manner as to constitute a material improvement.

It remains to be seen to what extent this form of motor can be satisfactorily used with petroleum and the heavier hydrocarbons, since it is possible that the cooling effect of the water spray may limit the machine to the use of benzine and similar fuels.

In any case it is an interesting example of the ingenuity which is being applied to the development of the internal combustion motor, which will doubtless ultimately aid in establishing its superiority as the heat motor of the immediate future.

Corliss Engines at the Exposition.

At the Philadelphia Centennial Exhibition the motive power was entirely furnished by the great Corliss engine which stood in the center of the machinery hall, while at Paris in 1878 Mr. Corliss received an award, although he made no individual exhibit, this distinction being given to him because of the extent to which his system of valve gear was shown by other builders. At the Paris exposition this year there might well be a similar recognition of the impress which Corliss has made upon steam engine design, for practically all the engines, with but few exceptions, show evidence of one or more of the points included in his system.

A large majority of the engines shown have the Corliss cylindrical valve, and where the movement is not given by the well-known wrist-plate action, some modification of it is employed. Even where, as in the well-known Sulzer and Culmann valve-gears, the poppet valve is employed, the Corliss principle of regulating the speed by varying the point of cut-off under control of the governor is retained, so that the action of the steam is practically that which he advocated.

The main advance which has been made over the practice which Mr. Corliss introduced is seen in the very general use of compounding, and this is mainly due to the fact that improved boiler practice enables pressures to be used sufficiently high to make compounding of advantage.

With the exception of minor details steam engine design at Paris showed adherence to a few fundamental points, and these may be enumerated as follows: The use of four valves to each cylinder; independent connections for each valve; a quick and wide opening of admission ports, with detached, quick closing movement, aided and controlled by the use of the dash-pot; the time of closing determined by the governor, regulating the speed by the point of cut-off; and the general use of compounding.

All these points, except the last, are due to Mr. Corliss, and it is not too much to say that the motive power section at Paris is a monument to the work of the American engineer.

REVIEW OF THE AMERICAN PRESS

The Height of Buildings.

AMONG the valuable papers presented before the recent convention of the American Society of Civil Engineers we may note an interesting discussion between Messrs. C. T. Purdy and Reginald P. Bolton, upon questions relating to the modern tall building. The subjects as proposed were: "What considerations should limit the height of buildings?" and "Do recent developments in construction, sanitation, intercommunication, and economy of administration, warrant the removal of all restrictions?"

The modern tall building is the outgrowth of demand for more room on a given site, and the hard conditions of competition, more than anything else, are responsible for its development. Under such circumstances any attempt to limit the height to which buildings may be erected must prove most difficult, since it cannot fail to discriminate between places and persons in a manner certain to arouse opposition.

Mr. Purdy, after a brief description of some details of tall building construction in New York and elsewhere, proceeds to enumerate some of the more important points to be considered in fixing or removing legal restrictions to the height of buildings.

Without going into these as fully as is done in his communication, the general points made are that tall buildings are objectionable because of the disturbing effect on land values, the exclusion of sunlight from the streets, the congestion of traffic, the difficulty of fire protection, and the excessive demands upon water supply and drainage facilities, to which may be added the æsthetic considerations, which should surely receive consideration.

In Mr. Purdy's view these objections are of minor importance for buildings not higher than fourteen or fifteen stories, but he is of opinion that the height of buildings should have a reasonable limitation. The newer buildings are undoubtedly superior to the earlier ones, both because of improvements in materials and methods, and because of the experience which has been gained in construction during recent years.

Mr. Bolton, who has had much experience in the equipment of tall buildings in New York, believes that the limitation of the height of buildings should be left to practical and economic action, and thinks that legislation or municipal interference cannot produce desirable results.

So far as some of the objections advanced by Mr. Purdy are concerned, they may be construed into positive advantages. The construction of a tall building on a neighboring lot, while temporarily interfering with the immediate supply of light, and, possibly to some extent, of air, enhances the value of the neighboring properties, since, on its success, they become equally capable of improvement. Very often the deep underground excavation and sub-soil drainage involved in tall building construction materially improves the sanitation of the surrounding district, both by revealing buried defects, and providing means of removal of leakage.

"The relative increase in the value of a piece of land, by reason of the construction of a lofty neighbor, may be gathered from what has proved to be the case in New York City.

"Land, which with four-story buildings has barely paid expenses and taxation, has, with a lofty building, been able to earn all expenses; pay interest at the rate of 4 per cent. upon mortgages, the extent of which greatly exceeds the value of the original buildings; also pay a largely increased taxation, sometimes as much as five times the old rating; and, finally, leave a substantial profit on the net capital invested."

There are certain natural restrictions which act to prevent excessive height unless accompanied by proportionate areas.

When a very tall building is erected upon a limited area the question of elevator service affects the desirability of the upper floors.

Again, the cost of maintenance of the upper floors in extremely high buildings is often disproportionate to their returns. In winter they demand an excessive amount of heat for warming, and the cost of water supply is at all times greater than for the lower floors.

Upper floors are generally considered more desirable by tenants, because of the removal from street noises and dust, and elevation above heated streets in summer. With imperfect elevator service, however, such as is sometimes unavoidably the case, the upper floors are practically removed by a distance of possibly 200 feet from the main street, with as much delay as if on the surface.

An important feature, noted by Mr. Bolton, is that in many large buildings the mechanical equipment reaches the proportions of a small central station, and can produce power in several forms under the most economical conditions. The fact that all the waste steam can be utilized for the necessary heating of the building in winter and for other useful purposes, such as heating water and cooking in summer, places these equipments in a position superior to the central station of public supplies.

It is capable of proof that supplies of power in several forms can be sold by such large buildings to neighbors at figures very much less than the present cost of public supplies. Such advantages may thereby be presented to a contiguous property as will of themselves overcome the objection to interference with light or air, and there is apparently no reason why a tall building should not, by such arrangements, be a source of improvement to its older neighbors, and thus directly, as well as indirectly, add to their value.

The Corrosion of Boiler Tubes.

ONE of the special difficulties now being encountered in the generation of steam on vessels, both of the American and British navies, is that of the pitting and corrosion of the boiler tubes, and this feature will doubtless form the subject of a portion of the report of the British Parliamentary commission, referred to elsewhere in this issue. At the same time the excellent paper of Lieutenant Commander Walter F. Worthington, U. S. N., published in the *Journal of the American Society of Naval Engineers*, is worthy of examination, as showing the experience which has been obtained in the United States Navy.

Mr. Worthington calls attention to the difficulty of drawing conclusions of any value from the ordinary records of various ships. The extent to which the various boilers are actually used is an important factor, also the service in which a ship is employed and the part of the world in which she has cruised. Some commanding officers and chief engineers are desirous of maintaining their boilers in a high state of efficiency, while others are anxious to keep down the cost of maintenance. When salt water has been permitted to enter the boiler the scale, although reducing the capacity of the boiler, and being dangerous to the combustion-chamber sheets and furnace crowns, has the effect of diminishing corrosion. Different kinds of fresh water also have different degrees of corrosive effect, and the conditions are so different in different cases, as to render it almost impossible to obtain comparable results.

For the above reasons it is undoubtedly advisable to look elsewhere than to naval records if we wish to learn anything about the corrosion of boiler tubes. Instead, Mr. Worthington examines the various causes to which corrosion may be due, and takes them up seriatim, in connection with such reliable experiments as may be available.

The usual reasons given for the corrosion of boiler tubes are as follows:

1. Fatty acids from decomposition of animal or vegetable oils.
2. Hydrochloric acid, due to the decomposition of the Mg Cl in sea water at a high temperature.
3. Galvanic action.
4. Use of salt water.
5. Presence of carbonic acid in water.
6. Presence of air in water.

Since only mineral oils are used in vessels of the United States Navy, it may be safely assumed that the first cause is absent. Experiments in connection with the liberation of hydrochloric acid by the decomposition of magnesium chloride, have

shown that while this is possible, the acid is always immediately appropriated by some base other than the boiler metal. If the corrosion in any case were due to hydrochloric acid, chloride of iron would be found in the boiler water, and this has not been done.

Galvanic action may be due to the different position on the electrical scale of clean iron or steel and mill-scale, since experiments have shown that when plates, which have not been freed from mill-scale are connected galvanically with plates free from mill-scale, an electric current, capable of being measured with a galvanometer, is set up. Corrosion from this source can only be prevented by removing the mill-scale from the water side of the tubes, or by using only seamless tubes, which are thoroughly pickled during the process of manufacture, and have no scale left on when completed, and by substituting galvanized steel or iron for brass internal feed pipes.

Sea water is known to be a better solvent of steel and iron than fresh water, and is also objectionable on account of the formation of scale. Fresh water should always be used, unless, in cases of great emergency, and if it was used exclusively galvanic action would be out of the question. All fresh water is not desirable, however, since the presence of organic matter is apt to cause the production of carbonic acid, enumerated under the fifth head above as a corrosive agent. Carbonic acid has been demonstrated to be an important factor in corrosion, not only because of its own direct action, but because it acts as a carrier for oxygen, and a very small quantity is sufficent, since it brings the oxygen into combination with the iron, itself not being used up in the operation. It is impossible to detect by litmus the presence of the small proportion of carbonic acid sufficient to cause this effect, and the only thing to be done is to test the water for organic matter, observing whether or no it is darkened by the addition of hydrosulphuric acid. As it is often impossible to choose the water which may be offered, the proper remedy is to provide sufficient evaporator capacity to render the vessel independent of outside sources of supply.

Air in water can only be removed by prolonged boiling, but in Mr. Worthington's opinion the presence of zinc has a considerable effect in neutralizing the oxygen.

"The tubes of our boilers may be made to last longer in the future than they have done in the past if engineers will be governed by the following rules, which have heretofore been more honored in the breach than in the observance: Allow no tube or plate to enter the construction of the boiler with mill scale on the side in contact with the water. Use galvanized iron or steel instead of brass for internal feed pipes. These may rust out, and should be made easily renewable. Provide evaporator power enough to insure a sufficient supply of fresh water, so that it will never be necessary to use either sea water or fresh water of doubtful quality from shore. Provide fresh water reserve tanks, so that the boilers will never have to be used as storage tanks. Keep all boilers closed, the water at a constant level and above the tubes, and, by use of caustic soda or caustic potash, at all times sufficiently alkaline to turn red litmus paper blue. Use zinc plates of the standard size, 12 inches by 6 inches by 1 inch, distributed beneath the surface of the water. Finally, keep the temperature of the feed tank up to nearly boiling at all times.

"After all this has been done by the engineer there still remains the problem for the tube manufacturer to furnish tubes of some material less corrodible than iron or steel, and above all, to produce tubes more uniformly corrodible. At present a lot of tubes are put into a boiler, side by side, under identical conditions in every respect. One of them will corrode through in six months and another in six years.

The American Society of Municipal Improvements.

THE recent convention of the American Society of Municipal Improvements, while not without value in itself, calls attention to what must be considered the present tendency to the multiplication of societies and similar bodies to an unnecessary and possibly injurious extent.

The present practice of engineering is actually tending more and more to unification in methods and products, the specialization being rather that of individuals than of working bodies, and it really seems as if the four great national societies, the Civil,

Mechanical, Mining, and Electrical engineers, should cover the ground far better than any number of smaller specialized bodies. Municipal engineering is mainly included in civil engineering, with the possible exception of some branches of waterworks practice, which fall under mechanical engineering, and it really seems as if membership in some one of the various grades of the national society would do more to further the work than any auxiliary organization.

The same is true of the society of heating and ventilating engineers, which is certainly entirely within the field of the mechanical engineers, and similar examples might be cited in connection with electrical engineering.

In regard to municipal engineering it may be maintained that much of its work relates to matters of administration, largely political in nature, and not such as would come before a society devoted solely to engineering. It is not to be expected that any technical society can exert an appreciable influence upon the domain of what has aptly been termed "practical politics," but there is no good reason why a society of civil engineers should not discuss details of management in municipal engineering. Some of the most valuable papers and discussions before the American Society of Mechanical Engineers have related to the economics of engineering, including works management, cost-keeping, and commercial work, and the trained engineer of to-day must possess some degree of familiarity with the business details of his profession if it is to be successful.

Municipal life, and indeed life in all parts of the country, is coming more and more under the rule of the engineer, and it is not too much to say that the time must come when the engineering side of government will dominate, just as the engineering side of warfare has already assumed control.

For such reasons it appears extremely unfortunate that there should be such division of effort and undoubted duplication of good work, as must necessarily follow when various branches of engineering are divided up among a number of minor societies, instead of being concentrated in the hands of some one of the great bodies containing members from all branches of the profession, and eminently capable of providing expert members for committees upon each department of engineering work. Instead of endeavoring to provide a society which should include politicians and local reformers, the engineering problems of municipalities should be freely and fearlessly discussed by engineers in their own existing organizations with such energy and publicity as to make the actions of interested political leaders too conspicuously defective as to permit them to continue.

The metropolis of the United States had, for too short a period, an able engineer at the head of one of the great municipal departments, with the result that that department became the admiration and imitation of the rest of the country. It required no municipal society to accomplish such a result, simply the placing of power in the hands of a competent engineer.

Some day, when engineering problems become even more the ruling questions of a city than now, the engineer will be the chief officer, and duties now attached to the ruling offices will be performed by minor clerks, but it is too much to expect such a desirable result to emanate from a host of minor associations.

American Engines in England.

In discussing some interesting phases of international trade in a recent issue of the *American Machinist,* Mr. W. H. Booth makes some comments well worthy the attention of American manufacturers.

No matter how well built or generally satisfactory a machine may be, if there are petty annoyances about it, due to neglect of minor details, dissatisfaction is certain to result. As an example Mr. Booth notes the unsatisfactory indicator gear attached to many steam engines sent to England from America.

"Nothing could be worse. There is a pillar carried off a slide-bar bolt. A lever swings from a loose and badly fitted pin in the pillar head, and there is a quadrant on the lever that does not provide a pull short enough for any high-speed engine indicator, so that it is useless. Beyond this, on the back stroke the swinging lever is drawn back hard against the hood, and has to be cut out to clear this. Such is the gear supplied, not of a single maker

only, thus proving that the gear had not been even put together, either in fact or on the drawing board."

Then there is the mistake of providing unfamiliar screw threads. In England the Whitworth thread is used exclusively, and while it may not be necessary to use Whitworth threads for bolts and permanent portions of the machine, yet for such purposes as indicator connections the standard three-quarter Whitworth inside thread should certainly be provided.

"As made, engines come over with all sorts of threads, and reducing nipples have to be made, and as the threads are not standard, they have to be cut on a lathe instead of being more easily and quickly screwed by taps or dies. A great defect noticed is the want of uniformity in small details. For example, two set-screws for securing similar cotters at the two ends of a valve-rod were not even alike in their heads. A separate spanner was required for each, and there was no reason of safety, or any other reason, why they should not be identical. The same remark applies to various nuts about this same engine. This is not an exceptional case, nor is it drawn from any engine made by an unknown firm or firms. I do not say that similar faults are not to be found here on English-made engines, but I name them because it is claimed that all American machinery is made interchangeable, and yet in scores of ways this is not the case with the productions of firms that stand high in their special lines. The system of interchangeable manufacture is one that should prevail, but it is an exceedingly bad system when only imperfectly carried out, and I know by experience that it often is very imperfectly carried out, even to the neglect of leading dimensions."

Mr. Booth has also some timely words about the commercial side of the machine trade in England. He affirms that no good and continuous business will be founded by any firms who are not prepared to grant exclusive agencies, and to act honorably by their agents. Agents of standing will not undertake business unless assured of permanency, because of the large initial expenses in building up a trade, and unless they have an exclusive right to a certain territory they may do a lot of work only to have the work taken out of their hands by some other agent, who has simply come in at the last minute. Principals often will not recognize the years of preliminary hard work by the agent, but grudge him anything more than a bare living when he begins to reap the reward of his accumulated labor.

"In other words, machine-tools, engines, and other vehicles, are not sold in Europe by placing samples in a storeroom and expecting customers to come and buy, but they are sold by the personal efforts of the traveler, much of whose success is due as much to his personal qualifications as to the qualities of what he has to sell."

The Regulation of Electric-Power Plants.

WITH the advent of large electric power plants, especially for long-distance transmission and supply, many points require consideration to a degree not demanded in earlier and smaller installations. For this reason the paper of Mr. F. A. C. Perrine, recently presented before the Pacific Coast Electric Transmission Association, is of value at the present time and some abstracts are given.

The regulation of an electric plant is often thought to refer only to the maintenance of the proper voltage at the lamps or motors, but in actual practice many more things demand consideration. Assuming the supply to be an alternating current, the periodicity must be maintained constant, which means that a uniform speed must be maintained at the motive power, in this discussion assumed to be supplied by water-wheels. The system of regulation must, therefore, be capable of controlling the speed of the wheels, irrespective of changes in the load and changes in the voltage. In the generators the regulation is one of voltage, and this must vary with varying load, even though a constant voltage may be required by the customer. The amount of voltage variation to be provided by the generator is partly governed by the step-up transformers, while in the line will be found a disturbing element which must be considered. The final adjustment of the voltage must be made in the sub-station, where the step-down transformers are placed.

Considering first the water-wheels, the

method of regulating the speed varies according to the head of water. With large turbines, operating under a low head of water at a moderate velocity, the regulation can be effected by variation of gate opening, although this involves a variation in efficiency, such wheels being much less efficient at part-gate than at full-gate. Attempts to regulate bucket openings, instead of gate openings, in order to increase the efficiency at part load, have been made, but such have, as yet, not come into general use.

With a high head of water, and with the corresponding high velocities, any attempt to regulate by varying the flow of water produces fluctuations in the pressure which are most objectionable and even dangerous. The methods suggested by Mr. Perrine, and in practical use, are those of a deflecting nozzle, or a deflecting hood, it being understood that in such plants the wheels are of the impulse type, a jet striking upon suitably shaped buckets attached to the periphery of the wheel. To these methods Mr. Perrine suggests the advisability of dividing the power among a number of wheels, so that the general demand may be nearly supplied by the number of wheels put in action, and the extent of necessary regulation reduced to a minimum. To this excellent suggestion may be added the possibility of using a method of regulating in which the wheel is split into two halves in a plane normal to the axis, these halves separating or approaching, and thus offering a varying capacity to the jet, as the load varies.

Passing to the electrical portion of a plant, uniform speed at the water wheel being assured, the generator, operated at the constant speed of the water wheel, should be adapted for variable voltage regulation. Machines designed for self-regulation at constant voltage are not generally satisfactory on long-distance transmission plants. It is customary to measure the regulating properties of the generator on a non-inductive load, while in a long-distance transmission a non-inductive load is an impossibility, the lines and transformers introducing at the generator an inductance which must be taken care of by the design of the machine.

With regard to the transformers, they should be designed to relieve the machines as far as possible of great necessity for variation as the inductive effect of the load changes. In consequence the specification of the inductive drop through a transformer is, in general, more important than a specification of the non-inductive regulation.

The line itself is perhaps the cause of the worst disturbing effect. Here we have not only an inductive drop, but also a heavy capacity current, the capacity current remaining practically constant at all loads while the inductive drop varies with the load. Reactance coils may be used to advantage at the sub-stations, not only to reduce the generator current and line loss at no load, but as sub-station voltage regulators.

In summing up, Mr. Perrine gives the following points as demanding careful consideration:

1. The sub-division of water-wheels, and the use of extremely high-speed machinery.

2. A wide range in the possible voltage variation in the generators, with generators and transformers both designed, not for good non-inductive load regulation, but for good inductive load regulation.

3. Lines designed for the smallest possible capacity current without reference to any attempt at balancing the line capacity against the load lag.

4. The use of reactance coils at the substation (instead of regulator heads on transformers) and wide range of regulators in feeder circuits.

Water Waste in New York.

THE question of the future water supply of New York City has been made the subject of two important reports, one presented by Mr. John R. Freeman to Comptroller Bird S. Coler, the other prepared by several engineers for the Merchants' Association. These reports are discussed very fully in a recent issue of *Engineering News*, from which some abstracts are made.

Both reports agree in the fact that New York is in danger of a disastrous water famine, unless active immediate steps are taken to secure a greater margin between the rapidly increasing demands for water and the available supply. The most important feature, however, is that this dan-

ger is shown to be very largely due to unwarranted and preventable waste.

The present consumption for Greater New York is 103 gallons per head per day, or 117 gallons for Manhattan and Bronx, and according to the studies of Messrs. Freeman, Croes, and Crowell, at least one-half of this is sheer waste. Of course other American cities are worse, notably Philadelphia, with its 200 gallons per head per day, but comparison with Philadelphia is hopeless, in view of the influences at work there.

The reports unite in showing the necessity of providing increased supply, but apart from increased supply comes the question of filtration, and unless the waste is restricted, and some reasonable limit placed upon the consumption, the cost of filtering the whole supply becomes prohibitory.

Mr. Freeman shows, by diagrams of the hourly consumption, that the minimum consumption in New York is never below 90 gallons per head per day, while in Fall River and Woonsocket, two cities in which meters are used, the minimum consumption is 5 gallons. In other words, each citizen of New York is charged with 90 gallons every day, which he does not and cannot use, and a large portion of which is flowing away while he sleeps. The comparison between New York and the above metered cities shows that the amount of water actually used is about the same in both cases, so that the introduction of meters works no hardship whatever, and does not cause any deprivation of water that could possibly be used.

Notwithstanding the evidence that a large proportion of New York's supply runs to waste, the advisory engineers despair of any permanent waste restriction being accomplished in the face of public opinion and official indifference. All that they appear to hope for is that such measures of restriction may be carried out to such an extent as will tide over the period needed to plan and construct new works.

These new works may draw their supply either from the Housatonic, or from the upper Hudson, but in either case they would involve the expenditure of immense sums of money and practically preclude the possibility of filtering the whole supply, as certainly should be done. In the meantime the waste is to be permitted to go on, in deference to the utterly unwarranted belief that too much water cannot be supplied if a city is to be healthful and clean. By and by it may be understood that health and cleanliness depend more upon quality than quantity, and that too much foul water may be a thing most undesirable, and perhaps still later it may be realized that sufficient quantity and satisfactory quality might have been obtained without increasing the supply at all, simply by cutting off the preventable waste and filtering the used remainder.

There seems to be little use in retaining distinguished engineers when it is a foregone conclusion that their recommendations are either not to be followed, or else are to be so tempered to meet public and political opinion as to be materially affected in value. Far better to have a drastic denunciation of current waste than a foolish evasion of the real issue, and place the responsibility where it properly belongs.

American Permanent-Way Construction.

THE increased service demanded of American railways during the past few years has resulted in a general advance in the construction of the permanent way, and with this has also come a tendency toward standardization, which, although not complete, is sufficiently marked to demand consideration. In a recent issue of *Engineering News* a very complete set of tables is given, showing the comparative details of track construction throughout the United States, Canada, and Mexico, indicating clearly the present character of construction as adopted and now in force for new work and renewals; the list comprising forty-seven of the principal lines in all parts of the United States, the two great railway systems of Canada, and three railways in Mexico.

Three tables are given, the first containing data concerning standard rails, fastenings, and joints; the second, information about ties, tie-plates and ballast, and the third being devoted to frogs, switches, etc. With the tables are given notes of explanation, and there is also an editorial discussion of the whole subject.

The early diversity in practice was doubtless partly due to lack of intercourse be-

tween those having such work in charge, and one of the greatest benefits which has been conferred upon the engineering profession, not only in railway affairs, but in all branches of work, is the comparison of ideas and methods, rendering it possible for each to profit by the experience of all the others.

This tendency toward standardization, as a result of association, is well shown in the matter of rail sections, the type of section recommended by the rail committee of the American Society of Civil Engineers having been very extensively adopted. In many cases the new sections are not yet fully laid, but as they have been adopted and are being laid on all new work and renewals, they will enable standardization to proceed continuously. Heavier rails are naturally the rule, most of the main lines having rails of seventy-five and eighty pounds per yard, and greater lengths are coming into use, 33 feet being common, 45 feet on the Lehigh Valley and Reading roads, and in some special cases 60 foot rails being used.

There has been little progress made in fastenings, the old spike still being in general service, experiments with screw spikes not having been generally continued. Improvement in this direction is much needed, and an examination of European practice suggested.

"In regard to rail joints, the extent of track laid with suspended and broken joints far exceeds that laid with supported joints and square joints. Many roads are using various forms of bridge joints, and a few have adopted such a form as standard, but in most cases they are regarded mainly as experimental or merely incidental. Only three roads report the three-tie joint as standard, and only eight report the supported joint."

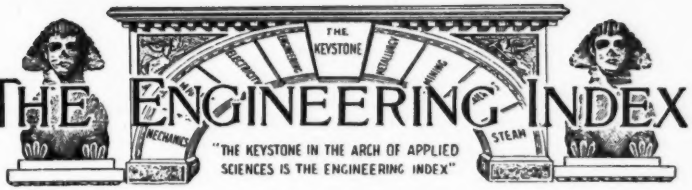
The important subject of ties is discussed as fully as the available data will permit, but the life of ties of nominally the same kind of timber varies for different parts of the country; oak from the south and southwest has a life of six to seven years, while oak from the northern part of the country lasts from fourteen to sixteen years. Steel ties are used on the Mexican Interoceanic Railway, their estimated life being thirty years, and their cost $2.25 in Mexican money.

Gravel ballast is more generally used than any other material, but stone is also extensively employed. Although the standard depth of ballast under the ties rarely exceeds twelve inches, the suggestion is made that a greater depth would be an advantage. The depth could readily be increased by raising the track and filling beneath.

In regard to frogs and switches, the bolted frog is in very general use. The old style plate frog is disappearing, but a combination type is in use in several cases, this consisting of rails bolted or clamped together and riveted to a base-plate. Spring rail frogs are almost universally used in main-line turnouts, only four or five roads still continuing to discountenance this type.

The objection may be on the ground of greater safety with the rigid frog, but in view of the experience with spring-rail frogs under the fastest and heaviest classes of traffic, this objection will hardly hold good. The split switch is now generally used, with either rigid or automatic switch-stands. On many important roads the main line turnouts are protected by distant signals, especially in cases where, owing to a curve or obstruction, the switch target cannot be seen at a distance by the engineman of an approaching train. The angles at the heels of frogs and switches are now generally provided with filling, so that a man's foot cannot get caught in the space below the rail head.

"Taken as a whole, the standards described in the tables show that the principal main lines, at least, have a sufficiently substantial form of track construction for the high-speed passenger trains and the enormously heavy freight trains which are now such a feature of American railway service."



The object of this Index is to supply all persons interested in engineering and industrial pursuits with, first, an expert descriptive summary clearly indicating the character and purpose of the leading articles published currently in the established technical journals of the United States, Great Britain, and the Continent—in all languages; and, secondly, an inexpensive means of readily obtaining any portions of this literature that may be desired by our readers.

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THE PUBLICATIONS REGULARLY REVIEWED AND INDEXED.

The titles and addresses of the journals regularly reviewed are given here in full, but only abbreviated titles are used in the Index. In the list below, *w* indicates a weekly publication, *b-w*, a bi-weekly, *s-w*, a semi-weekly, *m*, a monthly, *b-m*, a bi-monthly, *qr*, a quarterly, *s-q*, semi-quarterly, etc. Other abbreviations used in the index are: Ill—Illustrated; W—Words; Anon—Anonymous.

American Architect. *w.* Boston, U. S. A.
American Electrician. *m.* New York.
Am. Engineer and Railroad Journal. *m.* New York.
American Gas Light Journal. *w.* New York.
American Geologist. *m.* Minneapolis, U. S. A.
American Jl. of Science. *m.* New Haven, U. S. A.
American Machinist. *w.* New York.
Am. Manufacturer and Iron World. w. Pittsburg, U. S. A.
American Shipbuilder. *w.* New York.
Annales des Pontes et Chaussées. *m.* Paris.
Architect. *w.* London.
Architectural Record. *qr.* New York.
Architectural Review. *s-q.* Boston, U. S. A.
Architect's and Builder's Magazine. *m.* New York.
Australian Mining Standard. *w.* Sydney.
Automobile Magazine. *m.* New York.
Automotor & Horseless Vehicle Jl. *m.* London.
Brick Builder. *m.* Boston, U. S. A.
British Architect. *w.* London.
Brit. Columbia Mining Rec. *m.* Victoria, B. C.
Builder. *w.* London.
Bulletin Am. Iron and Steel Asso. *w.* Philadelphia, U. S. A.
Bulletin de la Société d'Encouragement. *m.* Paris.
Bulletin of Dept. of Labor. *b-m.* Washington.
Bulletin of the Univ. of Wisconsin, Madison, U. S. A.
Bull. Int. Railway Congress. *m.* Brussels.
California Architect. *m.* San Francisco, U. S. A.
Canadian Architect. *m.* Toronto.

Canadian Electrical News. *m.* Toronto.
Canadian Engineer. *m.* Montreal.
Canadian Mining Review. *m.* Ottawa.
Chem. Met. Soc. of S. Africa. *m.* Johannesburg.
Colliery Guardian. *w.* London.
Compressed Air. *m.* New York.
Comptes Rendus de l'Acad. des Sciences. *w.* Paris.
Consular Reports. *m.* Washington.
Contemporary Review. *m.* London.
Deutsche Bauzeitung. *b-w.* Berlin.
Domestic Engineering. *m.* Chicago.
Eclairage Electrique. *w.* Paris.
Electrical Engineer. *w.* London.
Electrical Review. *w.* London.
Electrical Review. *w.* New York.
Electrical World and Engineer. *w.* New York.
Electrician. *w.* London.
Electricien. *w.* Paris.
Electricity. *w.* London.
Electricity. *w.* New York.
Elektrizität. *b-w.* Leipzig.
Elektrochemische Zeitschrift. *m.* Berlin.
Elektrotechnische Zeitschrift. *w.* Berlin.
Elettricita. *w.* Milan.
Engineer. *w.* London.
Engineer. *s-m.* Cleveland, U. S. A.
Engineers' Gazette. *m.* London.
Engineering. *w.* London.
Engineering and Mining Journal. *w.* New York.
Engineering Magazine. *m.* New York & London.
Engineering News. *w.* New York.
Engineering Record. *w.* New York.
Eng. Soc. of Western Penn'a. *m.* Pittsburg, U. S. A.
Fire and Water. *w.* New York.
Foundry. *m.* Detroit.
Gas Engineers' Mag. *m.* Birmingham.
Gas World. *w.* London.
Génie Civil. *w.* Paris.
Gesundheits-Ingenieur. *s-m.* München.
Giorn. Dei Lav. Pubb. e d. Str. Ferr. *w.* Rome.
Glaser's Ann. f. Gewerbe & Bauwesen. *s-m.* Berlin.
Horseless Age. *m.* New York.
Ice and Refrigeration. *m.* New York.
Indian and Eastern Engineer. *m.* Calcutta.
Iron Age. *w.* New York.
Iron and Coal Trades Review. *w.* London.
Iron & Steel Trades Journal. *w.* London.
Iron Trade Review. *w.* Cleveland.
Journal Assn. Eng. Societies. *m.* Philadelphia, U. S. A.
Journal of Electricity. *m.* San Francisco.
Journal Franklin Institute. *m.* Philadelphia.
Journal of Gas Lighting. *w.* London.
Journal Royal Inst. of Brit. Arch. *s-qr.* London.
Journal of Sanitary Institute. *qr.* London.
Journal of the Society of Arts. *w.* London.
Journal of U. S. Artillery. *b-m.* Fort Monroe, U. S. A.
Journal Western Soc. of Eng. *b-m.* Chicago,
Journal of Worcester Poly. Inst., Worcester, Mass.
L'Energie Electrique. *w.* Paris.
Locomotive. *m.* Hartford, U. S. A.
Locomotive Engineering. *m.* New York.
Machinery. *m.* London.
Machinery. *m.* New York.
Marine Engineering. *m.* New York.
Marine Review. *w.* Cleveland, U. S. A.
Metal Worker. *w.* New York.
Mem. de la Soc. des Ing. Civils de France. *m.* Paris.
Mines and Minerals. *m.* Scranton, U. S. A.
Mining and Sci. Press. *w.* San Francisco, U. S. A.
Mining Reporter. *w.* Denver, U. S. A.
Mitt. aus d Kgl. Tech. Versuchsanst. Berlin.
Mittheilungen des Vereines für die Förderung des Local und Strassenbahnwesens. *m.* Vienna.
Modern Machinery. *m.* Chicago.
Moniteur des Architects. *m.* Paris.
Moniteur Industriel. *w.* Paris.
Municipal Engineering. *m.* Indianapolis, U. S. A.
National Builder. *m.* Chicago.
Nature. *w.* London.
Nature. *w.* Paris.
Nautical Gazette. *w.* New York.
New Zealand Mines Record. *m.* Wellington.
Nineteenth Century. *m.* London.
North American Review. *m.* New York.
Oest. Monatsschr. f. d. Oeff. Baudienst. *m.* Vienna.
Oest. Zeitschr. f. Berg- & Hüttenwesen. *w.* Vienna.
Ores and Metals. *w.* Denver, U. S. A.
Plumber and Decorator. *m.* London.
Popular Science Monthly. *m.* New York.
Power. *m.* New York.
Practical Engineer. *w.* London.
Pro. Am. Soc. Civil Engineers. *m.* New York.
Proceedings Engineers' Club. *qr.* Philadelphia, U. S. A.
Proceedings St. Louis R'way Club, *m.* St. Louis, U. S. A.
Progressive Age. *s-m.* New York.
Railroad Car Journal. *m.* New York.
Railroad Gazette. *w.* New York.
Railway Age. *w.* Chicago.
Railway & Engineering Review. *w.* Chicago.
Review of Reviews. *m.* London & New York.
Revue de Mécanique. *m.* Paris.
Revue Gen. des Chemins de Fer. *m.* Paris.
Revue Technique. *b-m.* Paris.
Revue Universelle des Mines. *m.* Liége.
Rivista Marittima. *m.* Rome.
Sanitary Plumber. *s-m.* New York.
Schweizerische Bauzeitung. *w.* Zürich.
Scientific American. *w.* New York.
Scientific Am. Supplement. *w.* New York.
Stahl und Eisen. *s-m.* Düsseldorf.
Stevens' Institute Indicator. *qr.* Hoboken, U. S. A.
Stone. *m.* New York.
Street Railway Journal. *m.* New York.
Street Railway Review. *m.* Chicago.
Telephone Magazine. *m.* Chicago.
Tramway & Railway World. *m.* London.
Trans. Am. Ins. Electrical Eng. *m.* New York.
Trans. Am. Ins. of Mining Eng. New York.
Trans. Am. Soc. of Civil Eng. *m.* New York.
Trans. Am. Soc. of Heat & Ven. Eng. New York.
Trans. Am. Soc. Mech. Engineers. New York.
Trans. Inst. of Engrs. & Shipbuilders in Scotland, Glasgow.
Transport. *w.* London.
Western Electrician *w.* Chicago.
Wiener Bauindustrie Zeitung. *w.* Vienna.
Yacht. *w.* Paris.
Zeitschr. d. Oest. Ing. u. Arch. Ver. *w.* Vienna.
Zeitschr. d. Ver. Deutscher Ing. *w.* Berlin.
Zeitschrift für Elektrochemie. *w.* Halle a. S.
Zeitschrift für Elektrotechnik. *s-m.* Halle a. S.

ARCHITECTURAL ENGINEERING

CONSTRUCTION.

Brickwork.

See Civil Engineering, Materials.

Chimneys.

See Mechanical Engineering, Steam Engineering.

Columns.

The Practical Column Under Central or Eccentric Loads. Continued discussion of paper by J. M. Moncrieff. 2000 w. Pro Am Soc of Civ Engs—Aug., 1900. No. 36095 E.

Dock Offices.

The Liverpool Dock Offices. Illustrations, with report and estimate, of plans which obtained the second prize in the recent competition. 6500 w. Archt, Lond—Aug. 3, 1900. No. 35795 A.

Factory.

A Steel-Concrete Factory Building. Illustrated description of a 125 x 135-ft., 2-story building, having a steel framework and walls and roof of concrete. 800 w. Eng Rec—Aug. 25, 1900. No. 36087.

Fire-Proof.

Fire-Proof Construction in North America (Feuerfeste Bauausführungen in Nordamerika). Karl Riensberg. A well illustrated account of methods of fireproof construction and materials used, principally in the high buildings of New York. Serial. 1st part. 4500 w. Stahl und Eisen—July 15, 1900. No. 35888 D.

Floors.

Reinforcing a Warehouse Floor. Illustrated description of a method of strengthening floors by means of king post trusses. 600 w. Eng Rec—Aug. 25, 1900. No. 36090.

Foundations.

Pneumatic Foundations in New York. Illustrates and describes recent work where cylindrical wooden caissons were used with speed and success. 700 w. R R Gaz—Aug. 17, 1900. No. 35973.

Girders.

See Civil Engineering, Construction.

High Buildings.

Height of Buildings. An informal discussion by Corydon T. Purdy and Reginald Pelham Bolton. Ill. 2500 w. Pro Am Soc of Civ Engs—Aug., 1900. No. 35097 E.

Joints.

Joints and Joinery. Fred T. Hodson. Illustrates and describes various kinds of joints. 1700 w. Arch & Builds' Mag—Aug., 1900. Serial. 1st part. No. 35743.

Office Building.

The Atlantic Mutual Insurance Company's Building. Illustrated description of the special pneumatic caisson foundations, cantilever column seats, and special steel work details in an 18-story office building on Wall st., New York. 3100 w. Eng Rec—Aug. 18, 1900. No. 36030.

The Buttenweiser Building, New York. Illustrated description of the special foundations and steel work details in an 11-story office building. 1100 w. Eng Rec—Aug. 4, 1900. No. 35724.

Paris Exposition.

The Exposition Palaces on the Esplanade des Invalides (Exposition de 1900. Les Palais de l'Esplanade des Invalides). Louis David. A well illustrated description of the Palace of Manufactures and the neighboring buildings, and their construction with a steel skeleton. 3000 w. 1 plate. Génie Civil—Aug. 4, 1900. No. 35884 D.

Roof Truss.

A Large Wooden Roof Truss. Illustrated description of the details of a 67-ft. truss for a large warehouse in Brooklyn. 600 w. Eng Rec—Aug. 18, 1900. No. 36029.

Staircases.

Spiral Staircases. W. and A. Mowat. From *The Stone Trades Journal*, England. Illustrated account of early construction, improvements, etc. 1700 w. Stone—Aug., 1900. No. 36100 C.

Tenements.

Low Rental Block Dwellings. A statement from several papers before the R. I. B. A. on the theoretically best arrangement of tenements, with notes on model buildings in several cities. 1600 w. Eng Rec—Aug. 11, 1900. No. 35756.

Theatre.

The Folly Theatre, Brooklyn. Illustrated description of the general arrangement and special steel work of a 100 x 150 ft. theatre, the first constructed under the New York building laws. 2000 w. Eng Rec—Aug. 11, 1900. No. 35757.

HEATING AND VENTILATION.

Artificial Heating.

Artificial Heating. W. M. Watson. The subject is viewed from the standpoint of the fitter, and discusses various systems.

Ill. 3200 w. Can Engr—Aug., 1900. Serial. 1st part. No. 35785.

Greenhouse.

A Modern Greenhouse Heating Plant. From *The Florists' Exchange*. Illustrates and describes the plant in a mammoth greenhouse establishment at Cromwell, Conn. 2000 w. Met Work—Aug. 18, 1900. No. 35962.

Hot-Water.

Low Pressure Hot-Water Heating. J. Nelson Russell. Read at meeting of Inst. of Heat and Ven. Engs., London. Considers this system efficient, easily attended to and economical. 2100 w. Met Work—Aug. 11, 1900. No. 35778.

Metropolitan Museum.

Ventilation and Heating in the Metropolitan Museum of Art, New York. Illustrated description of a plant designed to show no source or method of heating to the observer. Fresh tempered air is forced through hidden direct radiators. 2200 w. Eng Rec—Aug. 18, 1900. No. 36031.

Steam Heating.

Steam Heating in a Tall Brooklyn Office Building. Illustrated description of a plant in a 14-story building, which will utilize the exhaust from the power plant for heating purposes. Special consideration was given to the design of the pipe work. 1700 w. Eng Rec—Aug. 4, 1900. No. 35725.

PLUMBING AND GAS FITTING.

Hot Water.

A Multiple Hot Water Supply. Illustrated description of an unusually complex system of plumbing for water supply in a large New York residence. 1500 w. Eng Rec—Aug. 11, 1900. No. 35759.

Domestic Hot Water Supply. Frederick Dye. Read at London meeting of the Inst. of Heat and Ven. Engs. An illustrated account of what happens when a tap is opened, and allied phenomena. 2500 w. Plumb & Dec—Aug. 1, 1900. No. 35794 A.

House Drainage.

A Model System of Plumbing. William S. MacHarg. Practical conclusions on the subject of house drainage, drawn from the writer's experience. 3000 w. Dom Engng—Aug. 15, 1900. No. 36058 C.

Some Thoughts on House Drainage. Robert Smeaton. A discussion of the essentials to a perfect system. 1400 w. Dom Engng—Aug. 15, 1900. No. 36057 C.

Mechanical Plant.

The Sanitary Equipment and Power Plant of a Modern Lodging House. Illustrated detailed description of these features in Mills Hotel, No. 1, New York City. 2800 w. Sci Am Sup—Aug. 11, 1900. No. 35932.

Sewerage.

See Civil Engineering, Municipal.

Superintendence.

The Superintendence of Sanitary, Hydraulic and Gas-Piping Work in Buildings. William Paul Gerhard. Discusses points intended as a help in such work. 3000 w. Archts & Builds' Mag—Sept., 1900. Serial. 1st part. No. 36142.

MISCELLANY.

Marble.

The Marble of Laas (Der Laaser Marmor). Heinrich Lenz. An illustrated description of a Tyrolese marble quarry and methods of working it. The marble is particularly adapted for artistic purposes. Serial. 2 parts. 3500 w. Wiener Bauindustrie Zeitung—July 26, Aug. 2, 1900. No. 36154 each D.

Pan-American Exposition.

Views of the Pan-American Exposition. Illustrates the Park Lake, the North Bay, the art palace, and the New York State building, with brief descriptions. 1700 w. Sci Am Sup—Aug. 4, 1900. No. 35651.

Twentieth Century House.

The House of the Twentieth Century (La Maison du XXe Siècle). A somewhat fanciful theoretical discussion of a house with all modern improvements, built on scientific and hygienic principles. Serial. 2 parts. 7000 w. Revue Technique—May 25, June 25, 1900. No. 35829 each D.

CIVIL ENGINEERING

BRIDGES.

Alexander III.

Engineering at the Paris Exposition of 1900 (Das Ingenieurwesen auf der Pariser Weltausstellung des Jahres 1900). Fritz Eiselen. An illustrated description of this highly artistic highway bridge, and its construction. Serial. 1st part. 2000 w. Deutsche Bauzeitung—July 14, 1900. No. 35801 B.

Cantilever.

A Cantilever Concrete Sidewalk. Illustrated description of a 5-ft. sidewalk carried on Hennibique concrete-steel brackets projecting from the face of a retaining wall. 500 w. Eng Rec—Aug. 4, 1900. No. 35718.

Economy.

Economy in Bridge Work. Editorial discussion of the need of radical changes

in the English method of bridge design. 2400 w. Engng—Aug. 3, 1900. No. 35-905 A.

Foot-Bridge.

Steel Arch Foot-Bridge Over the Seine at Paris. Illustrated description. 500 w. Eng News—Aug. 30, 1900. No. 36145.

German Bridges.

German Bridge-Building. Exhibits at the Paris Exhibition. An account of the exhibits of the six leading German firms devoted to the design and construction of metallic bridges. 3200 w. Engng—Aug. 10. 1900. Serial. 1st part. No. 36-006 A.

Highway.

Comparative Estimates of the Cost of Combination and All-Steel Highway Bridges. H. G. Tyrrell. Shows that in the bridge in question the combination bridge cost one-third less than the steel one. 300 w. Eng. News—Aug. 23, 1900. No. 36065.

The Wellsville Over-Grade Bridge. Illustrated description of a light highway bridge, affording a clearance of 22 ft. over the rail base, with the floor surface only 23 ft. above the base. 600 w. Eng Rec—Aug. 4. 1900. No. 35717.

Improvements.

Bridge Improvements on the Bangor and Aroostook R. R. Illustrations, with brief description. 800 w. Ry & Engng Rev—Aug. 11, 1900. No. 35925.

Plate Girder.

Plate Girder Park Foot-Bridge at Madison, N. J. Illustrated description. 200 w. Eng News—Aug. 23, 1900. No. 36-068.

Railway Bridges.

The Bridge Work of the Pittsburg, Bessemer & Lake Erie and Union Railways. Illustrated descriptions of details and features of novelty. 4300 w. Eng News—Aug. 16. 1900. No. 35963.

Suspension.

Note on a New Type of a Rigid Suspension Bridge (Note sur un Nouveau Type de Pont Suspendu Rigide). M. Gisclard. A description, with diagrams, of a suspension bridge, stiffened by two trusses hinged at the center. Serial. 1st part. 2800 w. Ann d Ponts et Chaussées—4th quarter, 1899. No. 35851 E + F.

Viaduct.

The Riverside Drive Viaduct, New York. Illustrated description of a viaduct 1,800 ft. long and 80 ft. wide, consisting of short masonry approaches, a 130-ft. steel arch, three of 18 ft., and twenty-two of 65 feet. The article illustrates all the special details of both masonry and steel work. 3800 w. Eng Rec—Aug. 25, 1900. No. 36083.

Vienna.

The Franzeus Bridge at Vienna. Illustrated translation of article, by F. Pfeuffer, on an arch highway bridge, giving his views on the æsthetic considerations governing bridge design. 2600 w. Eng Rec—Aug. 18, 1900. No 36028.

CONSTRUCTION.

Arched Ribs.

A Simple Method of Calculating the Curve of Equilibrium, or Line of Thrust, in Arched Ribs. Charles Leon. The method is explained by illustrations of the cases which may occur in practice. 1800 w. Engr, Lond—Aug. 3, 1900. No. 35-912 A.

Columns.

See Architectural Engineering, Construction.

Excavators.

Smulder's Excavators. Illustrated description of some interesting exhibits at the Paris Exposition. 1300 w. Engng—Aug. 3, 1900. No. 35904 A.

Foundations.

See Architectural Engineering, Construction.

Girders.

Counterbracing Girders. Considers the two methods usually adopted for counterbracing the open webs of trusses and girders. 2000 w. Engr, Lond—July 27, 1900. No. 35739 A.

The Depth of Girders. Discusses the conditions and economic depth of girders. 2300 w. Engr, Lond—Aug. 17, 1900. No. 36109 A.

Groined Arch.

Diagram for Determining the Volume of Semi-Elliptical Groined Arch Vaulting. John H. Gregory. Gives a diagram for simplifying the mathematical work, with explanation. 350 w. Eng News—Aug. 23, 1900. No. 36063.

Lighthouses.

The Evolution of Lighthouses (Die Konstructive Entwickelung der Seefeuer). M. Geitel. A paper before the Verein Deutscher Maschinen-Ingenieure, giving an illustrated account of the historical and technical development of lighthouses; based on a forthcoming book by Veitmeyer. Serial. 2 parts. 15000 w. Glaser's Annalen—July 15, Aug. 1, 1900. No. 35877 each D.

Masonry.

The Injection of Cement, by Means of Compressed Air, into Masonry Structures (Note sur l'Emploi d'Injection de Ciment à l'Air Comprimé dans les Maconneries, Terrains de Fondations, etc.) M. Caméré. An illustrated description of an apparatus and the method used for pre-

venting cracks in masonry, with results of experiments. 1500 w. Ann d Ponts et Chaussées—1st quarter, 1900. No. 35863 E + F.

Piles.

A Hydraulic Screwing Machine for Driving Screw Piles. Charles William Anderson. Abstract of a paper presented to the Institution of Civ. Engs. Describes the machine and its operation under varying conditions. 1000 w. Eng News—Aug. 9, 1900. No. 35944.

Roads.

Note on the Maintenance of the French National Highways (Note sur l'Aménagement de l'Entretien des Routes Nationales par Rechargements Cylindrés et sur les Resultats Obtenus dans l'Arrondissement du Sud du Departement des Ardennes). M. Perrin. An account of the system followed, with tables. 3000 w. Ann d Ponts et Chaussées—1st quarter, 1900. No. 35861 E + F.

Roof Truss.

See Architectural Engineering, Construction.

Tunnels.

The Machinery Employed and Methods of Construction Adopted at the Simplon Tunnel. Charles Beresford Fox. Abstract of a paper read before the Inst. of Civ. Engs. of Gt. Britain. An account of the undertaking, with description of constructive details. 6500 w. Eng News—Aug. 30, 1900. No. 36147.

Some Tunnel Re-Construction on the Baden State Railways (Ueber einige Tunnel-Umbauten auf den Grossh. Badischen Staats-Eisenbahnen). J. Rosshändler. An illustrated account of the rapid repairing and enlargement of three tunnels, without interrupting traffic. 1100 w. Deutsche Bauzeitung—June 23, 1900. No. 35800 B.

Wind Pressure.

Wind Pressure (Winddruck). R. Kohfahl. A general discussion of the subject, with illustrations, diagrams and tables. 5000 w. Zeitschr d Ver Deutscher Ing—Aug. 4, 1900. No. 35874 D.

HYDRAULIC AND WATER SUPPLY.

Canals.

A Waterway 4,000 Kilometers Long between the Baltic and Caspian Seas (De la Mer Baltique à la Mer Caspienne; une Voie de Navigation de 4,000 Kilomètres). MM. Suquet and Fontaine. An account of a canal system between St. Petersburg and the Volga River, and improvements of the latter, with map and illustrations. 25000 w. 1 plate. Ann d Ponts et Chaussées—1st quarter, 1900. No. 35856 E + F.

Canal between the Marne and Saone Rivers, France (Canal de la Marne a la Saone). Gustave Cadart. A full description of the canal, 151 kilometers long, though not yet finished, with maps, plans and illustrations. 21000 w. 4 plates. Ann d Ponts et Chaussées—4th quarter, 1899. No. 35849 E + F.

Final Report of the Special Commission on the Chicago Drainage Canal. Abstract of the final reports recently issued. 2400 w. Eng News—Aug. 9, 1900. No. 35946.

Coffer Dam.

Partial Failure of Coffer Dam, New Dry Dock, Boston Navy Yard. Frank O. Maxson. Illustrated description of the failure of a coffer dam over 40 ft. high and 36 ft. wide. 2000 w. Eng Rec—Aug. 4, 1900. No. 35716.

Conduit.

Experimental Test of a Concrete and Expanded Metal Conduit for the Jersey City Water Supply. R. Godfrey. Illustrated description of the section designed and tested. 700 w. Eng News—Aug. 30, 1900. No. 36143.

Filtration.

Filtration of Water for Public Use. By Rudolph Hering, Philip H. Palmer, and E. Perrett. An informal discussion of the processes in use, their sanitary effect, cost, and reliability. 3300 w. Pro Am Soc of Civ Engs—Aug., 1900. No. 36099 E.

Graded Filters for Large Quantities of Water (Filtres Degrossisseurs pour Grandes Masses D'Eau). A. Puech. An illustrated description of filters in which the water passes successively through beds of gravel which at first is rough and grows finer and finer. 3400 w. Mem d l Soc d Ing Civils de France—Nov. 10, 1900. No. 35844 G.

The Filtration of Water for Public Use. Résumé of a discussion at the London meeting of the Am. Soc. of Civ. Engs. 4000 w. Jour Gas Lgt—July 24, 1900. No. 35653 A.

The Marlborough Brook Filter Beds; Metropolitan Water Supply for Boston and Vicinity. Brief account of these beds, the cost of construction, etc. 1000 w. Eng News—Aug. 30, 1900. No. 36148.

Flow.

On the Flow of Water Over Dams. Continued discussion of paper by George W. Rafter. 6000 w. Pro Am Soc of Civ Engs—Aug., 1900. No. 36094 E.

Harbors.

Harbors of Tunis (Les Ports Tunisiens). G. Leugny. A well illustrated account of harbor improvements at Tunis and Sousse, in Tunis, with tables showing amount of traffic and port charges. 3000 w. Revue Technique—July 25, 1900. No. 35837 D.

Irrigation.

Irrigation in the United States. Elwood

Mead. Describing the influences which retard the development of irrigation works in the United States. 2200 w. Eng Rec —Aug. 25, 1900. No. 36086.

Lake Levels.

The Changes of the Great Lake Levels. From *Chicago Inter-Ocean*. Comments on the changes in level and the effect of the drainage canal on Lake Michigan. 1400 w. Am Archt—Aug. 4, 1900. No. 35705.

Measurement.

Water Measurement and Manipulation in Colorado. H. A. Crafts. Illustrations with description of the method of distributing water for irrigation purposes. 1600 w. Sci Am—Aug. 11, 1900. No. 35929.

Resistance.

The Resistance of Immersed Bodies and Application of the "Sine Square" Formula (Résistance des Carènes, Essais de Joëssel et Formule du "Sinus Carré"). A. Duroy de Bruignac. An illustrated description of experiments to determine the pressure on surfaces immersed in running water, and discussion of formulæ; with tables. 4000 w. Mem d l Soc d Ing Civils de France —No. 12, 1900. No. 35846 G.

River Improvement.

A Discussion on the Protection of River Banks (Vereins-Angelegenheiten. Einleitzung zu einer Besprechung über Uferversicherungen). Paul Klunzinger. An address before a branch of the Oest. Ing. und Arch. Verein, giving an illustrated description of various methods of construction. 3000 w. Zeitschr d Oest Ing u Arch Ver—July 20, 1900. No. 35894 B.

On the Regulation of Rivers (Ueber Flussregulirungen). Ignaz Pollak. A general discussion of the improvement of rivers, tending to show that mere straightening is not effective; with diagrams. 7000 w. Zeitschr d Oest Ing u Arch Ver—Aug. 3, 1900. No. 35895 B.

The Improvement of the South Pass of the Mississippi River. William Starling. Map with description of the delta and passes, and full account of work on the South Pass. 10000 w. Eng News—Aug. 23, 1900. No. 36059.

The Relation between the Configuration of the River Bed and the Depth of the Channel in the Lower Schelde, Belgium (Hydraulique Fluviale. Etude sur la Corrélation entre la Configuration du Lit et la Profondeur du Chenal dans l'Escaut Maritime). M. Fargue. It was found that the depth was greatest where the concavity of the curves was sharpest. Illustrated by maps and diagrams. 2800 w. 2 plates. Ann d Ponts et Chaussées—1st quarter, 1900. No. 35855 E + F.

The Moselle Canal Day in Metz (Der Moselkanaltag in Metz). Projects for the improvement of the Moselle River, so as to make it navigable up to Metz, discussed at a meeting of the Verband für Kanalisirung der Mosel und Saar. 5500 w. Stahl und Eisen—Aug. 1, 1900. No. 35891 D.

Sterilization.

The Sterilization of Drinking Water (La Sterilisation des Eaux Alimentaires). Albert Bergé. An illustrated description of a sterilizing process in which chlorine peroxide is used, any excess of the latter being afterward removed by filtering through coke. 2800 w. Mem d l Soc d Ing Civils de France—No. 11, 1900. No. 35845 G.

Water Pollution.

The Bacteriology of Soils with Reference to the Pollution of Water. A review of investigations for the British Local Government Board, showing that the presence of certain innocuous bacteria in drinking water, taken in connection with other facts, may be of aid in determining its sanitary quality. 1400 w. Eng Rec—Aug. 11, 1900. No. 35758.

The York Water Pollution Case. A review of the decision of the Pennsylvania Supreme Court in Commonwealth *v.* Yost, restricting the powers of the State Board of Health and refusing to approve the criminal prosecution by a private corporation without powers of eminent demand against anyone polluting its source of supply. 1300 w. Eng Rec—Aug. 11, 1900. No. 35751.

Water Power.

The Utilization of the Yonne River for Supplying the Town of Chateau-Chinou, France, with Drinking Water and Electric Light (Notice sur l'Adduction des Eaux de l'Yonne pour l'Alimentation de Chateau-Chinou et l'Eclairage Electrique de la Ville). MM. Pochet and Assy. An illustrated description of the work, comprising dam, power plant, aqueduct, reservoir, etc. 4000 w. 1 plate. Ann d Ponts et Chaussées—1st quarter, 1900. No. 35857 E + F.

Water Purification.

Operation of the Water Settling and Filtration Plant at Albany, N. Y. Gives results of nearly a year's operation of this plant. 1700 w. Eng News—Aug. 9, 1900. No. 35942.

Purification and Filtration of Drinking Water for the Paris District (Epuration et Filtration des Eaux d'Alimentation de la Banlieue de Paris). MM. Veilhan and Regnard. A general description of the Anderson process, and the results achieved. 4000 w. Ann d Ponts et Chaussées—1st quarter, 1900. No. 35859 E + F.

The Removal of Iron from Water (Die Enteisenung des Grundwassers). G. Oesten. A paper before the Berlin branch of the Verein Deutscher Ingenieure, giving an illustrated description of methods

of removing iron from spring and well water, principally by aeration and filtration. 4000 w. Zeitschr d Ver Deutscher Ing—July 28, 1900. No. 35872 D.

Water Supply.

Report of the Merchants' Association on the Water Supply of Greater New York. Gives reports of committees appointed to investigate the whole subject of the present and future supply. 9000 w. Eng News—Aug. 23, 1900. No. 36069.

The Merchants' Association Report on the New York Water Supply. A statement of the conclusions reached by a committee of 33 representatives of engineering, legal, and business interests, concerning the best method, financial and from an engineering standpoint, of supplying New York with water for the next 40 years. 2700 w. Eng Rec—Aug. 25, 1900. No. 36082.

The Water Waste and Future Water Supply of Greater New York. Editorial on the information given in the reports of the Merchants' Assn., and of John R. Freeman. 2300 w. Eng News—Aug. 23, 1900. No. 36062.

Water Waste.

The Ratio of Water Wasted to That Used. A letter from C. Baillairgé, describing experiments to determine water waste in Quebec. 700 w. Eng Rec—Aug. 18, 1900. No. 36033.

Water-Works.

Godalming Water-Works. An account of the conditions in an English town, and the means taken to increase the supply. 2000 w. Engng—Aug. 3, 1900. Serial. 1st part. No. 35903 A.

New Water-Works Extension in Glasgow. J. A. Stewart. Brief illustrated account of an extension of more than local importance, to cost $5,000,000. 1200 w. Sci Am Sup—Aug. 18, 1900. No. 36014.

The Little Falls, Minn., Water Contract. The full text of a decision of the U. S. Circuit Court, denying the right of cities to abrogate long-time franchise contracts on the ground of excessive rates, without positively proving the charges to be exorbitant. 2500 w. Eng Rec—Aug. 25, 1900. No. 36089.

The Rate of Water Consumption. Illustrated review of an analysis, by John R. Freeman, of the hourly rate of consumption in New York, Brooklyn, Woonsocket, Fall River, and Providence, showing that the variations are practically uniform in all these cities. 1700 w. Eng Rec—Aug. 4, 1900. No. 35720.

The Water-Works of Leighton Buzzard, England. Illustrated description of a plant noteworthy for a water tower with a gas engine pumping plant within its base. The tank is arranged so as to partly eliminate the iron salts dissolved in water. 1200 w. Eng Rec—Aug. 25, 1900. No. 36084.

The White Plains Water-Works. Illustrated description of a low masonry dam, a unique method of increasing ground water supplies, by the run-off from an adjacent catchment area and a special standpipe valve. 2700 w. Eng Rec—Aug. 25, 1900. No. 36085.

MATERIALS.

Brickwork.

Bricks and Brickwork in Engineering Construction. Review of a lecture by Dr. A. C. Elliott, delivered to the Brit. Assn. of Water-Works Engs., on the "Strength of Brick and Brickwork." 1500 w. Jour Gas Lgt—July 31, 1900. No. 35788 A.

Cement Tests.

Relations Between Physical and Chemical Tests of Cement. An abridgement of a report by Otto H. Klein and S. F. Peckham to the New York Commissioners of Accounts. Gives a new scheme of cement analysis that claims to establish a law of correspondence between the physical properties and chemical composition of cement. Also editorial. 5400 w. Eng Rec—Aug. 4, 1900. No. 35721.

Relations Between Physical and Chemical Tests of Cement. A letter from Chas. F. McKenna, discussing new methods of analysis recommended in a report of the Commissioners of Accounts of New York City, and printed in the *Eng. Rec.* of Aug. 4. 1600 w. Eng Rec—Aug. 18, 1900. No. 36032.

Testing Cement by the Modulus of Rupture for Transverse Strain. John Paterson. A summary of results of experiments for ascertaining the modulus of rupture, and some of the conclusions. 5000 w. Engr, Lond—Aug. 10, 1900. No. 36009 A.

Corrosion.

See Mining and Metallurgy, Iron and Steel.

Reinforced Concrete.

Experiments on the Action of Sea Water upon Concrete-Steel (Expériences sur l'Alteration des Ciments Armés par l'Eau de Mer). M. Lidy. Experiments which show that electrolytic actions take place, which cause deterioration of the steel or iron. 2200 w. Ann de Ponts et Chaussées—4th quarter, 1899. No. 35853 E + F.

The Resistance of Materials (Résistance des Materiaux). A theoretical discussion, with particular reference to concrete-iron construction. Serial. 1st part. 1400 w. Revue Technique—June 25, 1900. No. 35833 D.

Spanish Laboratory.

The Madrid Engineering Laboratory (Le Laboratoire du Matérial du Génie à

Madrid). M. Mesnager. A short account of a military engineering laboratory at Madrid, for testing materials, etc., with plan, abstracted from a report of the director, Col. J. Marva y Mayer. 500 w. Ann d Ponts et Chaussées—1st quarter, 1900. No. 35862 E + F.

Testing.

The International Congress of Testing Materials of Construction. Briefly reviews papers of A. L. Colby, Henry M. Howe, and W. R. Webster. 6200 w. Ir Age—Aug. 9, 1900. No. 35923.

Timber.

The Influence on the Quality of Timber of the Time When It Is Felled (Ueber den Einfluss der Fällungszeit auf die Qualität der Nutz-und Bauhölzer). H. Schiller-Tietz. A discussion of the physical and chemical changes that occur in timber at different seasons, and the best time for cutting. 2000 w. Deutsche Bauzeitung—July 14, 1900. No. 35802 B.

Timber Preservation.

A Proposed Method for the Preservation of Timber. Discussion of paper by F. A. Kummer. 4000 w. Pro Am Soc of Civ Engs—Aug., 1900. No. 36096 E.

The Preservation of Timber. A statement of recent suggestions regarding methods of preserving timber, and a hint concerning the reason that treated timber ties last longer in Europe than in the United States. 1000 w. Eng Rec—Aug. 18, 1900. No. 36024.

The Rapid Seasoning and Fireproofing of Timber by Electricity (La Sénilisation Rapide et L'Ignifugation des Bois par L'Electricité). G. Leugny. An illustrated description of a method of impregnating timber with preservative and fireproofing salts by electrolytic action. 3000 w. Revue Technique—June 10, 1900. No. 35830 D.

Z-Bar Stresses.

The Stresses in the Edges of Z-Bars (Die Randspannungen in Z-Eisen). H. Rosskothen. A paper before the West Prussian branch of the Verein Deutscher Ingenieure, containing a mathematical discussion of the subject, with diagrams. 2500 w. Zeitschr d Ver Deutscher Ing—Aug. 4, 1900. No. 35875 D.

MUNICIPAL.

Cesspools.

The Cesspool. Leonard P. Kinnicutt. From an address before the Mass. Assn. of Boards of Health. A comparison of primitive and modern methods of treating sewage. 3200 w. Munic Engng—Aug., 1900. No. 35656 C.

Municipal Plants.

Municipal and Private Ownership of Water, Gas and Electric Light Plants in the United States. Editorial discussion of the report just published by the U. S. Dept. of Labor. 4000 w. Eng News—Aug. 9, 1900. No. 35945.

Paris Exhibition.

Municipal Engineering Exhibits at the Paris Exposition. Describes exhibits of interest, especially the display made by the city of Paris. Ill. 2000 w. Eng News—Aug. 2, 1900. No. 35690.

Pavements.

A Defense of Australian Hard-Wood Pavements. From a pamphlet by Sir Edward H. Wittenoom, in reply to disparaging remarks made by D. J. Ross. 2500 w. Eng News—Aug. 23, 1900. No. 36061.

Tar-Macadam Pavement in Ontario. Information concerning a pavement recommended for excellence, durability, and cheapness. 600 w. U. S. Cons Repts, No. 815—Aug. 23, 1900. No. 36051 D.

The Action of Water on Asphalt Pavements. Daniel B. Luten. An account of a series of experiments made by the writer, and the conclusions drawn. 2600 w. Eng News—Aug. 16, 1900. No. 35966.

Sewage Disposal.

Bacterial Sewage Disposal During the Past Year. George Thudichum. A paper read before the Assn. of Mun. and Co. Engs., reviewing the details in which improvements have been made; with an abstract of the discussion. 6300 w. Eng Rec—Aug. 11, 1900. No. 35754.

Septic Sewage Disposal at Liberty, N. Y. Illustrated description of a plant to dispose of the sewage of a resort where land for filtration was unobtainable. 1200 w. Eng Rec—Aug. 18, 1900. No. 36025.

Sewage and Garbage Disposal in China. Reports by John Fowler and J. W. Ragsdale, U. S. Consuls at Chefoo and Tientsin. 1000 w. Eng Rec—Aug. 11, 1900. No. 35755.

The Indiana Sewage Disposal Law. Analysis of the decision of the Supreme Court of Indiana, permitting the pollution of streams by the sewage from towns, but forbidding it in the case of sewage of industrial establishments. 2600 w. Eng Rec—Aug. 4, 1900. No. 35715.

The Management of Sewage Farms. A statement, by H. Royle, of the methods employed in Stretford to prevent land sickness and yield good effluents. 1900 w. Eng Rec—Aug. 4, 1900. No. 35723.

The New Jersey Sewage Disposal Law. A discussion by James Owen, of the law prohibiting the pollution of New Jersey streams after 1904. 1800 w. Eng Rec—Aug. 4, 1900. No. 35719.

The Purification of Trade Wastes. W. O. E. Meade-King. Abstract of a paper before the Inst. of C. E., describing experiments to determine satisfactory methods of purifying waste liquors from

various industrial establishments. 4400 w. Eng Rec—Aug. 25, 1900. No. 36088.

Sewage Farms.

The Healthfulness of Milk from Dairies on English Sewage Farms. Interesting information given in a recent report of Frederick W. Andrews, to the Secretary of State for War. 1000 w. Eng News—Aug. 16, 1900. No. 35967.

Sewerage.

The Principles of Drainage and Sewerage. A discussion of the principles that should govern the construction, with some consideration of cost. 2800 w. Dom Engng—Aug. 15, 1900. No. 36056 C.

Sewers.

The Main Sewers of Dijon, France (Les Grands Collecteurs de la Ville de Dijon). Charles Mocquery. A full and well illustrated description of the Dijon sewer system. 25000 w. 6 plates. Ann d Ponts et Chaussées—1st quarter, 1900. No. 35854 E + F.

Streets.

The Evolution of City Streets. Williston Fish. Discusses the importance of roads, with suggestions for street car development in serving cities. 4800 w. St Ry Rev—Aug. 15, 1900. No. 35993 C.

Trade Wastes.

The Purification of Trade Wastes. Abstract of a description by R. A. Tatton, before the Inst. of C. E., of methods of treating soap and dye waters from manufacturing establishments in the Mersey and Irwell district. 1800 w. Eng Rec—Aug. 18, 1900. No. 36026.

MISCELLANY.

Education.

Some Considerations Affecting the Training of Young Engineers. W. C. Borrowman. On the educational requirements and means of meeting them. Also discussion. 20000 w. Trans of N. E. Coast Inst of Engs & Shipbuilders—June, 1900. No. 35986 F.

ELECTRICAL ENGINEERING

COMMUNICATION.

Cables.

French Cable Projects. From the report of the commission appointed to examine the question of a system of submarine telegraph lines to connect certain colonies with the mother country. A map showing the proposed lines is given. 1600 w. Elect'n, Lond—Aug. 10, 1900. No. 35998 A.

French Submarine Telegraphy (La Télégraphie Sous-Marine en France). H. Casevitz. A general review of the subject, including cables, ships, laying and grappling for cables; with tables of comparative statistics, and maps showing cables of world. 10000 w. 1 plate. Mem d l Soc d Ing Civils de France—No. 7, 1900. No. 35838 G.

Insulated Cables at the Paris Exhibition. Comments on the exhibits, noting the great extension of the employment of fibrous materials in place of rubber and gutta-percha. 3200 w. Engng—July 27, 1900. No. 35733 A.

Electrical Apparatus.

The Exhibit of Electrical Novelties at Kiel (Die Ausstellung Elektrotechnischer Neuheiten in Kiel). Alfred A. Reimer. An illustrated description of various electric appliances for marine use, particularly telegraph indicators, exhibited on the occasion of the annual meeting of the Verband Deutscher Elektrotechniker. 2500 w. Schiffbau—July 23, 1900. No. 35825 D.

Long Distance.

Prof. Pupin's Proposed System for Long-Distance Telephoning. H. T. Wade. Discusses the results attained in long-distance telephoning and increase in rate of speed in the operation of ocean cables. 2300 w. Eng News—Aug. 23, 1900. No. 36067.

Printing Telegraph.

The Kübler Printing Telegraph (Typendrucker von Kübler). An illustrated description of a step-by-step printing telegraph apparatus with a very simple transmitter. 800 w. Elektrotech Zeitschr—July 19, 1900. No. 35806 B.

Ship Telegraph.

The New Electric Telegraph Signal Apparatus of the Allgemeine Elektricitäts Gesellschaft on the Rotary Field Indicator System (Die Neuen Elektrischen Kommandoapparate der Allgemeinen Elektricitäts Gesellschaft nach dem "Drehfeldfernzeiger-System"). F. Querengässer. A paper before the Verband Deutscher Elektrotechniker, giving an illustrated description of an apparatus for transmitting signals and orders of various kinds on shipboard. 1400 w. Elektrotech Zeitschr—July 19, 1900. No. 35805 B.

Space Telegraphy.

Prof. Braun's System of Wireless Telegraphy (Telegraphie ohne Draht nach dem System des Prof. Braun-Strassburg). The transmitter is a Leyden jar, with self-induction in its discharge circuit, which

sends out longer waves than the customary apparatus. 900 w. Elektrizität—July 21, 1900. No. 35819 C.

Telephone Exchange.

The New Telephone Exchange No. 1 in Berlin (Das Neue Fernsprech-Vermittelungsamt I. in Berlin). H. Lindow. A well illustrated description of switchboards, wiring and many other details. 3200 w. Elektrotech Zeitschr—July 26, 1900. No. 35810 B.

Telephone Recorder.

Recording Telephones. Describes the "Telephonograph" and the "Telegraphone," two recent inventions of a recording telephone. Ill. 2000 w. Nature—Aug. 16, 1900. No. 36120 A.

The Poulsen Telephonograph (Der Telephonograph von Poulsen). An illustrated description of this apparatus for making a magnetic record of telephone messages on a steel wire or ribbon, which record can reproduce the message at will. 1200 w. Elektrizität—June 23, 1900. No. 35817 C.

The Telegraphone. From *La Nature*. Illustrated description of the instrument and its applications. 1200 w. Sci Am Sup—Aug. 25, 1900. No. 36048.

The Telephonograph (Die Weltausstellung in Paris 1900. Der Telephonograph). Hans Zopke. An illustrated description of Poulsen's "telegraphon," for recording telephonic messages magnetically on steel wire or tape, with its many applications. 1600 w. Glaser's Annalen—Aug. 1, 1900. No. 35878 D.

Telephones.

Interior Telephone Systems. W. S. Henry. Describes the working of intercommunicating systems. Ill. 2500 w. Am Elect'n—Aug., 1900. No. 35664.

Some Interesting Faults on Telephone Circuits. Illustrated explanation of the cause of various disturbances. 1200 w. Elec Rev, Lond—July 27, 1900. No. 35748 A.

The Dardeau Direct-Call Telephone. Describes the system, illustrating the instrument. 1600 w. Engng—July 27, 1900. No. 35732 A.

DISTRIBUTION.

Earthing.

On "Earthing" and Earth Connections. A discussion of this subject, suggested by Mr. Wordingham's recent paper. 1800 w. Elec Rev, Lond—Aug. 10, 1900. No. 35989 A.

Fuse Protection.

The Evolution of Safe and Accurate Fuse Protective Devices. Joseph Sachs. Discussion of this paper, which was published in the Feb. issue, both in New York and Chicago. 25500 w. Trans Am Inst of Elec Engs—June and July, 1900. No. 35997 D.

Line Wire.

The Use of Aluminum Line Wire and Some Constants for Transmission Lines. F. A. C. Perrine and F. G. Baum. Presents the results of a careful study of this wire. Concludes that aluminum can be safely used in place of copper when proper precautions are taken. 7500 w. Trans Am Inst of Elec Engs—June and July, 1900. No. 35996 D.

Paris Exposition.

The Service Switchboards of the Paris Exposition, Electricity Building. Illustrates and describes the two switchboards, one used for continuous currents and the other for alternating currents. 2500 w. Elec Wld & Engr—Aug. 18, 1900. No. 35975.

Power Distribution.

Electrical Power Distribution. W. E. Ayrton. Discusses the four Electric Power Distribution Bills, recently before the British Parliament, and the benefits to follow. 5000 w. Nature—July 26, 1900. No. 35740 A.

Scattered Areas.

The Distribution of Electricity to Scattered Areas. L. Andrews. Read at Leeds, Eng., before the Munic. Elec. Assn. Deals with alternating *vs.* continuous currents for thinly populated sections. 2500 w. Elect'n, Lond—Aug. 10, 1900. No. 36000 A.

Switching.

The Evolution of Switch Gears for High-Pressure Alternating Currents. W. E. Warrilow. Part first is introductory to descriptions of apparatus used for dealing with currents at 2,000 volts pressure. 1300 w. Elec Engr, Lond—Aug. 10, 1900. Serial. 1st part. No. 36015 A.

Temperature.

On the Heating of Underground Cables (Ueber die Erwärmung Unterirdisch Verlegter Kabel). Dr. Richard Apt. Theoretical discussion, and results of experiments with alternating currents, with diagrams, tables and curves. 2800 w. Elektrotech Zeitschr—July 26, 1900. No. 35807 B.

ELECTRO-CHEMISTRY.

Electro-Galvanizing.

Some Notes on Electro-Galvanizing. Sherard Cowper-Coles. Illustrates and describes the process and recent improvements. 1400 w. Prac Engr—Aug. 10, 1900. No. 36021 A.

Electro-Metallurgy.

Electro-Metallurgy in 1899 (L'Electrometallurgie en 1899). P. Chalon. A general review of progress during the year.

3200 w. Rev Universelle d Mines—March, 1900. No. 35866 F.

Electro-Photography.

Curious Electro-Photographic Experiments. Illustrates and describes experiments made by Francis E. Nipher, as reported in a paper contributed to the Trans. of the Acad. of Science of St. Louis. 1500 w. Elec Rev, Lond—Aug. 10, 1900. No. 35988 A.

Paris Exposition.

Electro-Chemistry at the Paris Exposition (Die Weltausstellung in Paris 1900. Elektrochemie). Dr. Chr. Heinzerling. A general review of the electro-chemical exhibit at Paris, including also electric furnaces and accumulators. 3600 w. Zeitschr de Ver Deutscher Ing—Aug. 4. 1900. No. 35873 D.

Soda and Chlorine.

The Electrolytic Production of Soda and Chlorine. James F. Hobart. Describes the process of separating the soda and chlorine. Ill. 1600 w. Am Elect n —Aug., 1900. No. 35665.

ELECTRO-PHYSICS.

Interrupters.

Electrolytic Interrupters. Benj. F. Bailey. A study of direct current curves, giving interesting photographs of discharges, etc. 3300 w. Elec Wld & Engr —Aug. 11, 1900. No. 35934.

Resistance.

Resistance Diagrams of Sections (Widerstandsbild von Querschnitten). Karl Oertling. Graphical and analytical methods for calculating the resistance of different cross-sections. 3500 w. 1 plate. Oest Monatschr f d Oeff Baudienst—Aug., 1900. No. 36153 G.

Thermo-Electricity.

Thermo-Electric Currents (Ueber Thermoelektrische Ströme). H. Egg-Sieberg. An illustrated account of experiments tending to confirm the hypothesis that the direction and intensity of thermo-electromotive forces depend upon the rate of fall of temperature in the conductors. 2000 w. Elektrotech Zeitschr—July 26, 1900. No. 35809 B.

GENERATING STATIONS.

Accumulator Switch.

Sectional Switch for Charging Accumulators (Sektionsschalter für Akkumulatorenladung). Arthur Löwit. A description of a switch with several contacts which facilitates the charging and discharging of batteries in various groupings; with diagram. 500 w. Elektrotech Zeitschr—Aug. 2, 1900. No. 35813 B.

Alternators.

Design of Alternators. H. F. Parshall and H. M. Hobart. Describes a method founded upon experimental data. Part first discusses inherent regulation, and excitation regulation. 1800 w. Engng—July 27, 1900. Serial. 1st part. No. 35731 A.

Polyphase Alternate-Current Machinery. Explains the action and construction. 3000 w. Col Guard—Aug. 10, 1900. Serial. 1st part. No. 36012 A.

Dynamo.

A Dynamo for the Direct Generation of a Uni-Directional Current (Dynamomaschine zur Direkten Erzeugung eines Gleichgerichteten Stromes). An illustrated description of a dynamo in which part of the armature winding is surrounded by a strangely paramagnetic substance, and part by a diamagnetic or non-magnetic substance. 600 w. Elektrizität—July 7, 1900. No. 35818 C.

The 3,000-Watt Augsburg-Nuremberg Engine and Helios Dynamo at the Paris Exposition (Exposition de 1900. Groupe Electrogène de 3,000 Kilowatts des Sociétés d'Augsbourg-Nuremberg et Helios). Alfred Boudon. An illustrated description of this group, consisting of a 4-cylinder horizontal engine directly connected to a dynamo which generates both simple-alternating and triphase currents. 3000 w. 1 plate. Génie Civil—July 28, 1900. No. 35882 D.

Electric Plants.

Some Figures on the Cost of Electric Power Plants. Philip Dawson. Examines the cost of the individual plant, and the relations between the power to be installed and the cost. 2400 w. Engng—July 27, 1900. No. 35734 A.

Gas-Electric Plants.

The Use of Gas Engines in Connection with Electric Power Plants. Philip Dawson. The first of a series of articles discussing the conditions which will, by the adoption of gas engines, enable a great economy to be effected in the production of electrical energy. 4200 w. Engng—Aug. 10, 1900. Serial. 1st part. No. 36002 A.

Paris Exposition.

Heavy Electrical Engineering at the Paris Exposition (Die Weltausstellung in Paris 1900. Die Starkstromtechnik). Prof. M. Friese. A general review of the generation of electrical currents at the Exposition, and their distribution for power and lighting. Serial. 1st part. 3600 w. Zeitschr d Ver Deutscher Ing—July 14, 1900. No. 35868 D.

The Central Station and Power Plant on the Champ de Mars (Pariser Weltausstellung 1900. Die Kraftcentralen auf dem Marsfeld). A. Weber. An illustrated description of the great generating plants at the Exposition, with tables of the engines and dynamos. Serial. 2 parts.

3000 w. Schweiz Bauzeitung—July 21, Aug. 4, 1900. No. 36155 each B.

Storage Batteries.

Some Results Obtained With a Storage Battery of Twenty Thousand Cells. John Trowbridge. Read at meeting of Am. Acad. of Arts and Sciences. An illustrated account of interesting experiments. 2400 w. Nature—Aug. 2, 1900. No. 35792 A.

Switchboards.

Modern Switchboard Practice. Frank C. Perkins. Part first discusses polyphase high-tension switchboards. Ill. 2500 w. W Elect'n—Aug. 18, 1900. Serial. 1st part. No. 35994.

Triphase.

The Triphase Electric Company's Plant at Asnieres. From *Le Génie Civil.* Illustrated description of a 20,000 K. W. plant arranged in an unusual manner to secure short steam piping and completely independent units. 2500 w. Eng Rec—Aug. 11, 1900. No. 35753.

HEATING AND WELDING.

Electric Heat.

The Possibilities of Electric Heat as Limited by the Cost of Production. Alton D. Adams. Does not consider electric heat desirable from the economical point of view. 1200 w. Eng News—Aug. 23, 1900. No. 36064.

LIGHTING.

Bordeaux.

The Electric Lighting of the Harbor of Bordeaux, France (L'Eclairage Electrique du Port de Bordeaux). Paul Meunier. An account of the arc-light system along the water front. 4000 w. 1 plate. Ann d Ponts et Chaussées—1st quarter, 1900. No. 35858 E + F.

Flickering.

Light Fluctuations and their Cure (Lichtschwankungen und ihre Beseitigungen). K. Schindler. A discussion of the causes of flickering and irregularity in electric lights, and means for remedying the trouble. 1500 w. Elektrotech Rundschau—June 15, 1900. No. 35820 B.

Gloucester.

Gloucester Electricity Works. Historical and descriptive account, with illustrations. 3300 w. Elec Rev, Lond—Aug. 3, 1900. No. 35791 A.

Nernst Lamp.

Nernst Lamp at the Exposition. Illustrated description of this interesting exhibit and its operation. 1300 w. Sci Am—Sept. 1. 1900. No. 36179.

Pan-American Exposition.

The Electrical Tower at the Pan-American Exposition. Edward Hale Brush. Illustration, with description of this feature of the exposition. 1500 w. Sci Am Sup—Aug. 4, 1900. No. 35650.

Street Lighting.

Street Lighting by Series Alternating-Current Arc Lamps. Arthur L. Rice. Describes two methods that might be used and give good results. 1800 w. Am Elect'n—Aug., 1900. No. 35660.

MEASUREMENT.

Chronograph.

The Application of Recording Apparatus in Electrical Measurements (Anwendung des Registrirapparates bei Elektrischen Messungen). W. Marek. An illustrated description of the use of the chronograph in electrical experiments, with tables of observations. 2000 w. Elektrotech Zeitschr—Aug. 2, 1900. No. 35814 B.

Hysteresis.

On Rowland's New Method for Measuring Electric Absorption, and Losses of Energy Due to Hysteresis and Foucault Currents, and on the Detection of Short Circuits in Coils. Louis M. Potts. Describes investigations made with the object of testing these methods. 6300 w. Am Jour of Sci—Aug., 1900. No. 35-647 D.

Meters.

Rate Meters. Howard Hendrickson. Read before the Pacific Coast Trans. Assn. Discusses the requirements of a perfect rate meter, and describes a mechanical device which is said to be accurate and not liable to get out of order. Ill. 3200 w. Jour of Elec—July, 1900. No. 35767.

Photometry.

Determination of the Average Spherical Intensity of a Light by a Single Reading (Die Bestimmung der Mittleren Räumlichen Lichtintensität durch nur eine Messung). R. Ulbricht. Illustrated description of apparatus and experiments. The source of light is placed inside a hollow sphere with reflecting interior surface, with a window through which the illumination is observed. 1800 w. Elektrotech Zeitschr—July 19, 1900. No. 35803 B.

The Photometry of the Arc. Abstract of a progress report by Prof. C. P. Matthews, of Purdue University, on a series of investigations being made, and presented at the annual meeting of the Nat. Elec. Lgt. Assn. Ill. 1800 w. Eng News—Aug. 9, 1900. No. 35943.

Standards.

Standards of E. M. F. John Henderson. States the conditions to be fulfilled by any satisfactory standard, and examines the behavior of various cells. Ill. 3500 w. Elec Eng, Lond—July 27, 1900. Serial. 1st part. No. 35750 A.

Testing.

The Work of the Physical-Technical German Imperial Laboratory from February, 1899, to February, 1900 (Thätigkeit der Physikalisch-Technischen Reichsanstalt in der Zeit vom Februar, 1899, bis Februar, 1900). A record of the electrical and magnetic work of the institution, abstrated from the Zeitschr. f. Instrk. Serial. 2 parts. 3500 w. Elektrotech Zeitschr—July 19, 26, 1900. No. 35811 each B.

Traction Meter.

A Meter for Measuring Tractive Force on Electric Tramcars. Gisbert Kapp. Translation of paper read before the Verband Deutsches Electrotechniker. Describes the apparatus, giving diagram and illustration. The height of the liquid indicates the tractive force. 2000 w. Elect'n, Lond—Aug. 17, 1900. No. 36127 A.

POWER APPLICATIONS.

Cranes.

The Operating of Continuous Current Electric Cranes (Ueber die Steuerung Elektrischer Gleichstromkrahne). Max Vogelgesang. An illustrated article describing controllers for electric cranes, with the theory of crane operation. 4000 w. Elektrotech Zeitschr—Aug. 2, 1900. No. 35812 B.

Cripple Creek.

Electric Power in Cripple Creek District. J. W. Dickerson. Illustrated detailed description of the power equipment. 1500 w. Mod Mach—Aug., 1900. No. 35658.

Electric Vehicles.

See Mechanical Engineering, Automobilism.

Induction Motors.

Alternating-Current Induction Motors. A. C. Eborall. Considers points connected with the construction, design and performance of modern single and polyphase induction motors, and recent developments. Ill. 3500 w. Elect'n, Lond—Aug. 17, 1900. Serial. 1st part. No. 36128 A.

Paris Exposition.

Two Electrically Driven Pumps at the Paris Exposition. Illustrated descriptions of the Riedler pump, and the Ehrhard and Sehmer pump. 1100 w. Elec Wld & Engr—Aug. 25, 1900. No. 36080.

Proving Ground.

The Electrical Equipment at the Indian Head Naval Proving Grounds. Illustrates and describes probably one of the most flexible equipments ever designed. 2800 w. Elec Wld & Engr—Aug. 25, 1900. No. 36078.

Pumping.

Some Data on Pumping by Electricity. Lewis A. Hicks. On the success of the centrifugal pump, and the cost of the plants and their operation. 1800 w. Jour of Elec—July, 1900. No. 35768.

Steel Works.

Electric Power in the Parkgate Steel Works, England. Illustrates and describes a recent installation in works of large capacity. 2300 w. Elec Wld & Engr—Aug. 4, 1900. No. 35703.

The Marchéville-Daguin Salt Works and Soda Works (Saline et Soudière de la Société Marcheville-Daguin et Cie). Ch. Dantin. An illustrated description of these works and their method of operation, in which an electric plant plays an important part. 5000 w. Génie Civil—July 28, 1900. No. 35883 D.

Tools.

Some Notes on the Electrolytic Drilling and Slotting of Metals. Sherard Cowper-Coles. Brief report of experiments, with illustrations. 300 w. Elec Rev, Lond—July 27, 1900. No. 35749 A.

TRANSMISSION.

Long Distance.

Limits of Electric Transmission. Alton D. Adams. Discusses long distance transmission from the coal mines to great cities, showing that it is not economical and not to be considered even if the fuel is free. 2000 w. Sci Am—Aug. 25, 1900. No. 36045.

I. Regulation in Long-Distance Transmissions. Frederic A. C. Perrine. II. Transmission System Regulation. C. L. Cory. Papers and discussion before the Pacific Coast Trans. Assn. Ill. 9700 w. Jour of Elec—July, 1900. No. 35765.

Storage Batteries.

Application of Storage Batteries to Transmission Systems. C. O. Poole. Read before the Pacific Coast Trans. Assn. Presents the advantages of storage batteries in central stations, and discusses their cost, maintenance, etc. Also general discussion. 4000 w. Jour of Elec—July, 1900. No. 35766.

MISCELLANY.

Dielectrics.

Dielectric Strength. Jas. Rowland Bibbins. A brief exposition of results of various experiments, especial attention being given toward the establishment of a secondary standard for use in ordinary shop tests of materials and apparatus. 3500 w. Elec Wld & Engr—Aug. 25, 1900. No. 36079.

Electric Shock.

Electric Shock. Describes the effect of the electric current on the human body, and illustrates the operation of resuscitation. 4500 w. Col Guard—Aug. 3, 1900. No. 35901 A.

Electrical Industry.

The Electrical Industry in America and Great Britain. J. R. Bainton. Extract from a paper before the Elec. Assn. of New South Wales. Contrasts the methods of these two countries. 2000 w. Aust Min Stand—July 5, 1900. Serial. 1st part. No. 35961 B.

Electricity.

Some Notes on Dr. R. C. Shettle's View of the Ultimate Nature of Electricity. Spencer L. Fletcher. States the view taken, and discusses the opinions of men of science. 2000 w. Elec Engr, Lond—Aug. 17, 1900. No. 36126 A.

Far East.

Electrical Possibilities in the Far East. Philip Jaisohn. This first article discusses electrical trade, electrical engineering and investments in Japan. 2200 w. Elec Wld & Engr—Aug. 4, 1900. Serial. 1st part. No. 35704.

German Society.

Minutes of the Annual Meeting of the Verband Deutscher Elektrotechniker at Kiel, June, 1900 (Verband Deutscher Elektrotechniker. Bericht über die 8. Jahresversammlung in Kiel, 17 bis 20 Juni, 1900). Full minutes, with reports of various committees. 23000 w. Elektrotech Zeitschr—Aug. 2, 1900. No. 35815 B.

Phonogram Archives.

The Phonogram Archives of the Vienna Academy of Sciences (Das Phonogramm-Archiv der Academie der Wissenschaften in Wien). An account of a plan for forming a large, scientific collection of phonograph records, and discussion of methods for their permanent preservation. 1600 w. Electro-Techniker—July 15, 1900. No. 35822 B.

Tesla's Inventions.

Some Novel Inventions of Nikola Tesla. J. Wright. Illustrates and describes an electrolytic meter, and other devices. 2000 w. Elec Engr, Lond—Aug. 10, 1900. No. 36016 A.

GAS ENGINEERING

Acetylene.

Acetylene Laboratory Burner. Arthur Lachman. From *Am. Chem. Jour.* Discusses the acetylene Bunsen burner, the properties of the acetylene blue flame, and the comparative operating expenses of acetylene gas and gasoline gas. 2000 w. Pro Age—Aug. 15, 1900. No. 35940.

The Technology of Acetylene. Review of a book by Vivian B. Lewes. 3800 w. Jour Gas Lgt—Aug. 21, 1900. No. 36140 A.

Acetylene Black.

Acetylene Black and its Derivatives (Le Noir d'Acétylène et ses Dérivès). E. Hubou. A description of a process of obtaining amorphous carbon by decomposing acetylene, with an account of the advantages of this acetylene black, and the utilization of the bye-products. 8000 w. Mem d l Soc d Ing Civils de France—No. 12, 1900. No. 35847 G.

Carburation.

Apparatus for Producing a Gas for Welsbach Lights (Appareil à Produire le Gaz Aérogène). MM. de Perrodil and de Morsier. A paper treating of the advantages of a gas rich in hydrocarbons for Welsbach lights, with description of the van Vriesland carburator-compressor; and the resulting discussion. 6000 w. Mem d l Soc d Ing Civils de France—No. 7, 1900. No. 35839 G.

Composition.

The Synthesis of Commercial Gases. L. P. Lowe. Read before the Pacific Coast Gas Assn. Aims to give a simple description of the composition of commercial gases. 4000 w. Am Gas Lgt Jour—Aug. 27, 1900. No. 36101.

Fire-Clay.

A Chapter on the Manufacture of Fire-Clay Material for Gas Works. Frederic Egner. Information concerning this product, which, it is hoped, will be of practical use to gas engineers. 2200 w. Am Gas Lgt Jour—Aug. 20, 1900. No. 35991.

Gas-Lamp.

The Scott-Snell Self-Intensifying Gas-Lamp. Illustrates and describes a novel invention, giving particulars regarding its operation. 2700 w. Jour Gas Lgt—Aug. 14, 1900. No. 36039 A.

Meters.

Automatic Meters: With a Comparison of the Price Charged for Gas Consumed by Slot and Ordinary Consumers. Paper read before the N. Brit. Assn. of Gas Mgrs., with discussion. 3500 w. Gas Wld—Aug. 4, 1900. No. 35797 A.

Petroleum.

Some Chemical and Physical Characteristics of California Petroleum. A. S. Cooper. Read before the Pacific Coast Gas Assn. Also brief discussion. 5000 w. Am Gas Lgt Jour—Aug. 20, 1900. No. 35990.

Power Gas.

The Production of Power from Blast Furnace Gases. Andrew Stewart. Discusses the progress made in utilizing these gases and the effect on the iron industry. 1400 w. Elec, Lond—Aug. 17, 1900. Serial. 1st part. No. 36119 A.

Processes.

Principles Involved in the Production of Gas by Different Processes, and Their Relative Values. W. Young. Read before the N. British Assn. of Gas Mgrs. Discusses in detail the use of coke, destructive distillation, how gas should be tested, and the best gas to supply, etc. 13800 w. Jour Gas Lgt—July 31, 1900. No. 35787 A.

The Investigation of Gas Processes. A. C. Humphreys. Read before the Pacific Coast Gas Assn. Review of experiences of one who has been investigating claims of gas processes for 25 years. Denounces the Hall process, which was recently tested. General discussion. 7500 w. Am Gas Lgt Jour—Aug. 13, 1900. No. 35783.

Retorts.

The Construction and Working of Inclined Retorts. W. R. Herring. Read before the N. Brit. Assn. of Gas Mgrs. Considers the method of constructing and working an inclined retort bench and the underlying principles. Ill. Also discussion. 7500 w. Gas Wld—Aug. 4, 1900. No. 35706 A.

Small Works.

Impressions of Small Gas-Works in Ireland. Percy Griffith. Read before the N. of Ireland Assn. of Gas Mgrs. Considers the ownership, capital, accounts, condition of works and mains, price, residual products, etc. 3500 w. Jour Gas Lgt—Aug. 21, 1900. No. 36141 A.

Smelting.

Blast Furnace Smelting by Water Gas. C. C. Longridge. Considers the use of water gas for lead ore smelting, thus illustrating its adaptability for blast furnace use. 2000 w. Engr, Lond—Aug. 17, 1900. No. 36108 A.

Temperatures.

Observations on Retorting and Condensing Temperatures. Forbes Waddell. Read before the North British Assn. of Gas Mgrs. An account of experiments made by the writer with the view of saving of heat and returning it to the setting, and of cooling the products more gradually. Gives results and discussion. 4000 w. Jour Gas Lgt—Aug. 14, 1900. No. 36040 A.

MARINE AND NAVAL ENGINEERING

Battleships.

The Battleship of the Future. F. C. Goodall and A. C. Holzapfel. Read before the Congress of Naval Archts., in Paris. Outlines the type of vessel which recent improvements in armor plate and guns has made possible, advocating increase in size. 2000 w. Naut Gaz—Aug. 9, 1900. No. 35780.

Boilers.

Navy Boilers. Editorial continuing the discussion of the Admiralty Memorandum as to the form of boiler for British warships. 3500 w. Engng—July 27, 1900. No. 35735 A.

Crane Regulations.

Crane Regulations at Newcastle, N. S. W. Regulations for the working of cranes and wharf at this port. 2600 w. U. S. Cons Repts, No. 810—Aug. 17, 1900. No. 35968.

Cruisers.

Hichborn's Protest. From a letter to the Secretary of the Navy on the subject of protected cruisers. 1800 w. Marine Rev—Aug. 23, 1900. No. 36073.

Fire.

Ships and Docks of the North German Lloyd Steamship Co. Destroyed by Fire. An illustrated account of the destructive fire of June 30, 1900. 700 w. Marine Engng—Aug., 1900. No. 35747 C.

Fouling.

The Fouling of Ships. W. H. Atherton. On the nature, effect, and prevention of fouling. Also an appendix and discussion. 8000 w. Trans of N. E. Coast Inst of Engs & Shipbuilders—June, 1900. No. 35987 F.

Freighters.

Steel Freighters "Pleiades" and "Hyades," for the Boston Towboat Co. Illustrated detailed description of vessels designed to carry freight in bulk; such as coal, grain, etc. 1800 w. Marine Engng—Aug., 1900. No. 35745 C.

Fuel.

Petroleum Fuel for Warships. Alton D. Adams. Presents the great advantages to be derived from petroleum fuel, but considers the present production inadequate and the price prohibitive. 1800 w. Sci Am—Aug. 11, 1900. No. 36028.

Germany.

Shipbuilding in Germany (Les Construction Navales en Allemagne). Raoul Dubreuil. An article giving the German naval program, and showing the wonderful development of shipbuilding in Germany in recent years, with tables of statistics. 2000 w. Revue Technique—July 10, 1900. No. 35835 D.

Grosser Kurfurst.

The North German Lloyd Steamer "Grosser Kurfürst" (Der Norddeutsche Lloyddampfer "Grosser Kurfürst"). An illustrated description of this large ocean liner. 800 w. Schiffbau—July 8, 1900. No. 35824 D.

Shipbuilding in Germany. George Crouse Cook. Illustrated description of Kaiserliche Werft, a German navy yard credited with the construction of many modern vessels of war. 1800 w. Marine Rev—Aug. 23, 1900. No. 36072.

Lake Steamer.

Fine New Great Lakes Passenger Steamer. Illustration with description of the "Chippewa," built for the Arnold Transit Co. 2000 w. Naut Gaz—Aug. 2, 1900. No. 35710.

Lighthouses.

See Civil Engineering, Construction.

Lightship.

Lightship No. 72 for the Diamond Shoals. Relates the difficulties experienced in protecting vessels from this point of danger, and gives illustration and brief description of the new vessel. 900 w. Marine Rev—Aug. 9, 1900. No. 35781.

Naval Machinery.

Machinery for the United States Navy Armored Cruisers. G. W. Melville. A brief comparison of the merits and demerits of the preliminary designs. Also editorial. 3400 w. Engr, Lond—Aug. 3, 1900. No. 35908 A.

Navigation.

The Navigation Interests of Nations in Ports and Waterways, and Modern Means for Their Improvement. Lindon W. Bates. Read at the International Congress on Navigation, at Paris. Considers improvement of waterways and terminal facilities. 5500 w. Naut Gaz—Aug. 23, 1900. No. 36053.

Schools.

Schools of Marine Engineering and Naval Architecture. George Crouse Cook. An illustrated account of the courses and conditions at Glasgow University, written by an American student. 2500 w. Marine Engng—Aug., 1900. No. 35746 C.

Shipping.

Japanese Shipping. An interesting review of recent developments. 2000 w. Engr. Lond—Aug. 3, 1900. No. 35910 A.

Ship Telegraph.

See Electrical Engineering, Communication.

Shipyards.

Recent Extensions at Fairfield Shipyard. Notes on recent improvements and new features. 2400 w. Engr, Lond—Aug. 17, 1900. No. 36110 A.

Steamer.

New Channel Steamer. The "Alberta." Illustrated description of a fast English passenger boat, built for night service. 1800 w. Naut Gaz—Aug. 16, 1900. No. 35980.

The Newhaven and Dieppe Channel Steamer "Arundel." Illustrations with description of vessel and equipment. 1100 w. Engng—Aug. 17, 1900. Serial. 1st part. No. 36104 A.

Submarine.

Submarine Navigation (La Navigation Sous-Marine). H. Noalhat. This part contains a review and discussion of various methods of directing the course of a submarine vessel. Serial. 1st part. 4500 w. Revue Technique—May 10, 1900. No. 35827 D.

Troopship.

The Indian Troopship "Hardinge." Illustrated description of a twin-screw vessel with a gross tonnage of about 5,600 tons, and a capacity for 1,400 troops and all accoutrements. 1700 w. Engr, Lond—Aug. 17, 1900. No. 36111 A.

Tugboats.

New Type Tugboat. Illustration and description of the "Delmar," combination harbor and sea-towing steamer. 1000 w. Naut Gaz—Aug. 9, 1900. No. 35779.

Wrecks.

Notes on Wreck Raising. David W. Noakes. Read before the Paris Congress of Naval Architecture. An account of operations conducted in the river Thames. 6500 w. Engng—Aug. 17, 1900. No. 36106 A.

Yachts.

On Yacht Measurements, Together with Some Remarks on the Action of Sails. H. C. Vogt. Read before the Inst. of Naval Archts. Discusses these subjects and the importance of framing a yacht-tonnage rule which is correct and easily understood. Considers the weight necessary to form such a measurement rule. 3500 w. Engs' Gaz—Aug. 1, 1900. No. 35789 A.

MECHANICAL ENGINEERING

AUTOMOBILISM.

Bearings.

Roller Bearings and Some Connected Matters. A discussion of the most suitable bearings for a motor vehicle, with abstract of patent specifications recently issued to Edw. P. Cowles. 2700 w. Horseless Age—Aug. 15, 1900. No. 35918.

Competitions.

Motor-Vehicle Competitions in France. Report of the competitions of 1898, of heavy weights, and of 1899, of motor-cars

plying as street cabs. 1200 w. Horseless Age—Aug. 22, 1900. No. 36038.

Cooling.

The Cooling of Explosion Motors. Extracts from the report of MM. Grouvelle and Arquembourg, at the International Congress. Discusses the two systems commonly employed. Ill. 2200 w. Horseless Age—Aug. 22, 1900. Serial. 1st part. No. 36037.

Electric Vehicles.

Electric Automobiles. William Baxter, Jr. Considers the limits in the present state of electrical development, and gives illustrated descriptions of various vehicles. 3000 w. Pop Sci M—Sept., 1900. No. 36130 C.

Fire-Tube Boilers.

Is the Fire-Tube Carriage Boiler Dangerous? Editorial discussion of recent criticisms of this type. 1400 w. Horseless Age—Aug. 22, 1900. No. 36036.

Heavy Vehicles.

Heavy Motor Vehicles for Road Service. F. M. Maynard. Mr. Maynard's second paper gives interesting details of design, construction and performance of leading British types of vehicles, with many illustrations of successful machines. 3000 w. Engineering Magazine—Sept., 1900. No. 36172 B.

Ignition.

A Storage Battery Spark Ignition. Hugh Dolnar. An illustrated detailed description of a spark outfit for mechanically propelled vehicles. 2000 w. Am Mach—Aug. 9, 1900. No. 35938.

Improvements.

The Future of the Automobile—Suggested Improvements. A discussion of the use of excessive powers, means of rendering the motor more elastic, etc. 2700 w. Sci Am Sup—Aug. 25, 1900. No. 36049.

Motor Car.

Capel's Motor Car. Illustrates and describes a vehicle containing many features of novelty. 1300 w. Auto Jour—Aug., 1900. No. 36121 A.

Motor Vehicles.

Automobiles. T. J. Martin. Considers the motive powers in practical use at present, with their comparative costs of operation. Also discussion. 2400 w. Jour Assn of Engng Socs—July, 1900. No. 35982 C.

Automobile Vehicles. Louis Derr. A discussion of the various methods by which vehicles of the present moment are propelled. 5300 w. Jour Assn. of Engng Socs—July, 1900. No. 35981 C.

Front-Driven Motor Carriages. Illustrates and describes various vehicles utilizing this idea. 2800 w. Auto Jour—Aug., 1900. No. 36122 A.

The Capel Motor Carriage. Illustrated description of a carriage propelled by an internal combustion engine using petroleum spirit. 700 w. Engr, Lond—Aug. 3, 1900. No. 35914 A.

HYDRAULICS.

Centrifugal Pumps.

The Schabaver Centrifugal Pumps (Rapports de M. Léon Masson, sur les Pompes Centrifuges Schabaver). Report on a special type of centrifugal pumps, for elevating liquids to great heights, with illustrations, and curves and tables of tests. 2000 w. Bull d l Soc d'Encouragement—June 30, 1900. No. 35865 G.

Hydraulic Equipment.

Hydraulic Engineering in the Metropolitan Power House. Illustrated detailed description of the water supply, fittings, plumbing and fire protection. 1800 w. Ir Age—Aug. 23, 1900. No. 36034.

Hydraulic Governing.

Commercial Requirements of Water-Power Governing. Elmer F. Cassel. A critical examination of the principles involved in the governing of water-wheels, and an exposition of an improved method. 2500 w. Engineering Magazine—September, 1900. No. 36171 B.

Hydraulic Jack.

Theory of the Hydraulic Jack. George F. Hodgins. Explanatory. 1500 w. R R Car Jour—Aug., 1900. No. 35920.

Power Improvements.

A New Rack and Other Improvements to the Feeder for the Middlesex Company, Lowell, Mass. Arthur T. Safford. Illustrates and describes work that gave increase of power, and simplified the conditions for controlling the water power. 4300 w. Jour Assn of Engng Socs—July, 1900. No. 35983 C.

Pump.

The Mammoth Pump. From *Ingeniøren*, Copenhagen. Abstract. Describes a method of raising water without any bucket or pump work, explaining the principle and gives several applications. 2300 w. Col Guard—Aug. 3, 1900. No. 35902 A.

Pumping.

See Electrical Engineering, Power Applications.

Pump Tests.

Tests of Centrifugal Pumps Under High Heads. Slightly condensed from a paper read before the Pacific Coast Elec. Trans. Assn. Describes the experimental tests of the pumps of the Kern County Land Co., explaining methods of testing and giving results. 4800 w. Eng News—Aug. 9, 1900. No. 35947.

Syphons.

Syphon Mains (Heberleitungen). Heinrich Adolf. An illustrated description of syphon plants for connecting artesian wells and raising water from rivers. 2300 w. Zeitschr d Oest Ing u Arch Ver—July 20, 1900. No. 35893 B.

Water Power.

The Clergue Enterprises at Sault Ste. Marie. An account of the industries developed to utilize the power of Lake Superior. 4500 w. Ir Age—Aug. 9, 1900. No. 35924.

See Civil Engineering, Hydraulics.

MACHINE WORKS AND FOUNDRIES.

Cranes.

A Twenty-five Ton Hydraulic Traveling Crane. Illustrates and describes a traveling crane recently installed in the Altoona shops of the Pennsylvania Railroad. 700 w. Am Mach—Aug. 9, 1900. No. 35939.

See Electrical Engineering, Power Applications.

Cupolas.

Charging a Cupola. Edward Kirk. Describes how to make a fire in a cupola, and other matters relating to its proper management. 2400 w. Foundry—Aug., 1900. No. 35673.

Cupola Practice. Edward B. Gilmour. Describes the cupola furnace and states its advantages, and considers the investigations of Mr. Hart as to causes affecting its working. 1100 w. Foundry—Aug., 1900. No. 35675.

The Cupola Practice in Bessemer Steel Works. S. M. Rodgers. Considers the circumstances and conditions governing the proper manipulation of the cupola. 1800 w. Foundry—Aug., 1900. No. 35678.

Dies.

Some Special Forming Dies. Joseph V. Woodworth. Illustrates and describes dies for forming cold-rolled sheet steel, .048 inch thick, to shape shown. 900 w. Am Mach—Aug. 16, 1900. No. 35959.

Factory.

See Architectural Engineering, Construction.

Flanges.

Turning Flanges on a Locomotive Boiler. H. D. Van Doorn. An illustrated description of the methods employed. 700 w. Am Mach—Aug. 23, 1900. No. 36041.

Gating.

Gating. Paul R. Romp. Discusses the manner in which a mold is gated. Ill. 800 w. Foundry—Aug., 1900. No. 35676.

Jigs.

Bending Jigs. Joseph V. Woodworth. Illustrates and describes bending in sheet metal that it would be impracticable to do in the press. 600 w. Am Mach—Aug. 23, 1900. No. 36044.

Lathe.

A Staff Lathe. A. H. Cleaves. Illustrated description of a machine used extensively in watch and clock work. 1000 w. Am Mach—Aug. 23, 1900. No. 36042.

Locomotive Works.

Some of the Interesting Features of the Schenectady Locomotive Works. Illustrations with description. 2500 w. Mach. N. Y.—Aug., 1900. No. 35640.

Punching.

Making Gears and Racks by Punching. Joseph V. Woodworth. Illustrated description. 800 w. Am Mach—Aug. 23, 1900. No. 36043.

Reorganization.

The Task of Reorganization. Considers the problem briefly, discussing the design, men, and methods. 3300 w. Engng—July 27, 1900. No. 35736 A.

Riveter.

A Large Hydraulic Riveter. Illustrated description of a machine designed by Ernest W. Naylor, for use in the Altoona shops. 800 w. Am Mach—Aug. 16, 1900. No. 35957.

Shrinkage.

Absolute Shrinkage. William Roxburgh. Discusses irregular shrinkage, considering design, equality of metal, slackening, comber, etc. 2300 w. Foundry—Aug., 1900. No. 35677.

Tools.

See Electrical Engineering, Power Applications.

Tool Steel.

The Taylor-White Process of Treating Steel. An illustrated account of a series of tests made to exhibit the quality of steel treated by this process. 1700 w. Am Mach—Aug. 16, 1900. No. 35956.

The Taylor-White Steel Process. A description of the results of a process for hardening tools, employed in the machine shops of the Bethlehem Steel Co. 1100 w. Eng Rec—Aug. 4, 1900. No. 35714.

Works Management.

Commercial Organization of the Machine Shop. Hugo Diemer. Prof. Diemer's fourth paper deals with the operation of the production department and with the actual execution of the work in the shop. 3000 w. Engineering Magazine—Sept., 1900. No. 36167 B.

MATERIALS OF CONSTRUCTION.

Corrosion.

See Mining and Metallurgy, Iron and Steel.

Elasticity.

The Error in Hooke's Law (Der Fehler in Hooke's Gesetz). Francis Rust. A simple experiment and a mathematical demonstration, showing that Hooke's law of elasticity is inadequate in the case of a beam fixed at one end and bent by its own weight. 3000 w. Oest Monatschr f d Oeff Baudienst—July, 1900. No. 36-151 G.

Expanded Metal.

Expanded Metal (Le Métal Déployé). An illustrated account of the manufacture and numerous applications of J. F. Golding's metal lattice-work invention. Serial. 1st part. 3200 w. Revue Technique—July 10, 1900. No. 35834 D.

Specifications.

International Standard Specifications for Steel and Iron. A discussion of the report of the American section of the International Assn. for Testing Materials. 6700 w. Col Guard—July 27, 1900. No. 35711 A.

POWER AND TRANSMISSION.

Air Compressors.

Explosions and Ignitions in Air-Compressors and Receivers. Alfred George White. From Pro. of Inst. of Civ. Engs. An account of an occurrence of this nature, with description of compressor, and discussion of cause. 1800 w. Am Mach—Aug. 2, 1900. No. 35669.

Belting.

A Study of Leather Belting (Etude sur les Courroies de Transmission). Robert Moulin. A discussion of leather belts, particularly of their strength and adhesion. 1800 w. Revue Technique—June 10, 1900. No. 35831 D.

Moving Stairways.

Moving Stairways at the Paris Exposition (Les Chenims Elévateurs à l'Exposition de 1900). J. Laverchère. A well illustrated description of several kinds of electrically driven, continuously moving inclined planes in operation at the Paris Exposition. 1500 w. Génie Civil—July 14, 1900. No. 35880 D.

Shafts.

Graphical Aids to the Design of Shafts Subject to Bending and Twisting. Robert A. Bruce. Diagram with explanation of its construction and use. 4000 w. Prac Engr—Aug. 17, 1900. No. 36123 A.

SPECIAL MOTORS.

Gas-Electric Plants.

See Electrical Engineering, Generating Stations.

Gas Engines.

Blast Furnace Gas Engine. Report of tests, conducted under direction of Prof. H. Hubert, of Liege Univ., with the Delamare-Deboutteville and Cockerill 600 h.-p. gas engine, consuming blast-furnace gas. 2200 w. Mod Mach—Aug., 1900. No. 35657.

Safety in Gas Engine Installation. J. D. Lyon. Discusses points in the installation of gas engines to secure safety. 1600 w. Ir Trd Rev—Aug. 2, 1900. No. 35668.

Some Notes on Larger Types of Gas Engines. J. B. Crockett. Read before the Pacific Coast Gas Assn. Gives a brief history of the best known engines previous to 1892, and describes the latest improvements. Ill. General discussion. 6500 w. Am Gas Lgt Jour—Aug. 6, 1900. No. 35708.

Test of a Blowing Engine Using Blast-Furnace Gas (Essai d'une Machine Soufflante à Gaz de Haut Fourneau). Abstract of a report of H. Huber, chief engineer, of a test of a 600 horse-power Cockerill gas engine using blast-furnace gases, at Seraing; with tables. 6000 w. Revue Technique—July 10, 1900. No. 35836 D.

Test of a 600-Horse-Power Blast Furnace-Gas Engine (Versuche an der 600 Pferdigen Gichtgasmaschine mit Gebläse, System Delamare Deboutville und Cockerill in Seraing). E. Meyer. An illustrated account of the tests made on this large blowing engine, using blast furnace gases. 4500 w. Stahl und Eisen—July 15, 1900. No. 35886 D.

The Körting Exhibit at the Paris Exposition of 1900 (Die Elektricität auf der Pariser Weltausstellung, Ausstellung der Firma Gebrüder Körting, Körtingsdorf bei Hannover). An illustrated general description of Körting gas engines directly connected to dynamos, on exhibition at Paris. 900 w. Elektrotech Zeitschr—July 26, 1900. No. 35808 B.

STEAM ENGINEERING.

Boiler.

Borrot Multitubular Boiler (Chaudeére Multitubulaire Borrot). An illustrated description of a water-tube boiler in which the tubes cross each other in the form of an X, making a convenient arrangement and saving space. 2000 w. Revue Technique—May 25, 1900. No. 35828 D.

Chimneys.

New German Rules for the Stability of Chimneys. Translation of the rules and notes for calculating the stability and strength of masonry stacks, drawn up by the Society of German Engineers, the International Union of Boiler Insurance Societies, and a number of specialists. 2000 w. Eng Rec—Aug. 18, 1900. No. 36027.

Compound Corliss.

Compound Corliss Steam Engine at the Paris Exposition (Exposition de 1900.

Machine à Vapeur Compound Corliss à Soupapes). An illustrated description of a 240-horse-power engine, with special pop-valves on the high-pressure cylinder and ordinary Corliss valve-gear on the low-pressure. 1000 w. 1 plate. Génie Civil—July 14, 1900. No. 35879 D.

Condensers.

A Note on the Use of Condensers in Power Stations. R. C. Carpenter. On the saving as compared with non-condensing engines, and the two kinds of condensers. 700 w. Am Elect'n—Aug., 1900. No. 35663.

Distilling.

Test of Distilling Plant at Dry Tortugas. R. K. Crank. Report of a six-day trial of the "Lillie" multiple effect distilling plant, Jan. 13 to 20, 1900. Ill. 2000 w. Ice & Refrig—Aug., 1900. No. 35706 C.

Condensers and Economizers. Alton D. Adams. Discusses their advantages and examines the objections. 1700 w. Elec Rev, N. Y.—Aug. 22, 1900. No. 36054.

Explosions.

Boiler Explosions Discussed. T. R. Parker. Considers modern boilers less likely to burst, and discusses various types. 2000 w. Am Mfr & Ir Wld—Aug. 23, 1900. No. 36071.

Thoughts Suggested by Boiler Explosions. T. R. Parker. Read before the Pacific Coast Gas Assn. Discusses the medium employed; the agent; the character of the material; and forms and types of boilers, and means of avoiding conditions which cause explosions. Also general discussion. 6700 w. Am Gas Lgt Jour—Aug. 13, 1900. No. 35782.

Feed-Water.

Purification of Feed Water. J. A. F. Aspinall. Abstract of a report on the purification of feed-water for locomotive boilers, with short editorial. 2500 w. R R Gaz—Aug. 24, 1900. No. 36081.

Furnaces.

Furnace Efficiency. W. H. Booth. Considers things affecting the efficiency of a furnace, the importance of a fireman's duty and related matters. 1500 w. Am Mach—Aug. 16, 1900. No. 35958.

Indicator.

The Continuous Recording of Steam Engine Performance. Prof. William Ripper. A detailed exposition of Prof. Ripper's continuous mean-pressure indicator, with examples of its application to recent Cunard steamers. 3000 w. Engineering Magazine—Sept., 1900. No. 36169 B.

Keying.

Keying Up an Engine. W. H. Wakeman. Describes the writer's practice in the engine room. 2000 w. Engr, U. S. A. —Aug. 15, 1900. No. 36022.

Paris Exposition.

Engines and Generators at the Paris Exposition. Illustrated description of some of the prominent exhibits. 2800 w. Am Elect'n—Aug., 1900. No. 35662.

Some Prominent Engines at the Paris Exposition. Illustrated detailed description of interesting engine exhibits. 5700 w. Power—Aug., 1900. No. 35645.

Pumping Engine.

Official Duty Tests of Pumping Engines Nos. 9 and 10, High-Service Station No. 3, St. Louis Water-Works, February 15-16 and 26-27, 1900. Nils Johnson. A summary of the results obtained and methods employed during the official duty tests of two 15,000,000-gallon, triple-expansion engines. 4400 w. Jour Assn of Engng Socs—July, 1900. No. 35985 C.

Test of a 30,000,000-Gallon Pump at Chestnut Hill, Boston. Gives the leading results of a 24-hour test of a triple-expansion engine, which developed 178,497,000-ft.-lbs. per thousand pounds dry steam. 600 w. Eng Rec—Aug. 4, 1900. No. 35726.

Superheating.

Saving by Superheated Steam. R. S. Hale, in *The Boiler*. Considers the value of superheating steam in reducing waste and describes three types of superheaters. 1600 w. Ir & Coal Trds Rev—July 27, 1900. No. 35729 A.

Trial.

Trial of an Allis Triple-Expansion Pumping Engine; Chestnut Hill Station, Boston Water-Works. Describes the plant and method of conducting the trial. Of interest because of the exceptional high duty attained. 2200 w. Eng News—Aug. 23, 1900. No. 36060.

MISCELLANY.

Abattoirs.

Municipal Abattoirs and their Mechanical Equipment (Städtische Schlachthöfe und deren Maschinelle Einrichtungen). Gustav Witz. An illustrated account of various machines, mechanical appliances and scientific methods used in slaughter-house work. 5000 w. Zeitschr d Oest Ing u Arch Ver—July 13, 1900. No. 35892 B.

Aeronautics.

Preliminary Experiments in Long Distance Aerial Navigation (Essais Préliminaires a la Navigation Aérienne au Long Cours). Léo Dex. A well illustrated account of a balloon and auxiliary apparatus, including heavy guide-rope, used in ascensions, with a view to determining the conditions for remaining in the air a week or more. Serial. 1st part. 3000 w.

Revue Technique—May 10, 1900. No. 35826 D.

The Ascension of Count Zeppelin's Airship. An illustrated account of the ascension on July 2. 1000 w. Sci Am—Aug. 11, 1900. No. 35930.

The Ascension of the Zeppelin Air-Ship (Rundschau. Auffahrt des Zeppelinschen Luftfahrzeuges). The personal report of Count Zeppelin to the Council of the Gesellschaft zur Förderung der Luftschiffahrt. 700 w. Zeitschr d Ver Deutscher Ing—Aug. 4, 1900. No. 35876 D.

Brewing.

Progress in Brewing Machinery (Fortschritte auf dem Gebiete der Brautechnik). H. Hempel. A paper before the Hessian branch of the Verein Deutscher Ingenieure, giving an illustrated description of modern machinery and methods used in brewing. Serial. 2 parts. 5000 w. Zeitschr de Ver Deutscher Ing—July 21, 28, 1900. No. 35870 each D.

China.

The Crisis in China. Its Meaning for Engineering Interests. Hon. John Barrett. Showing the identity of interests among the great industrial nations, with especial reference to the engineering development of the empire. 3000 w. Engineering Magazine—Sept. 1900. No. 36-174 B.

Gun Carriage.

The Howell Disappearing Carriage. Illustrated detailed description of the machine and its operation, giving brief report of tests. 800 w. Sci Am—Aug. 25, 1900. No. 36047.

Ice Machines.

Vacuum Ice Machines. Alfred Siebert. Calculation of the theoretical economy. 1800 w. Ice & Refrig—Aug., 1900. No. 35707 C.

Mexico.

Three Large Franco-Mexican Industries in Mexico (Trois Grandes Industries Franco-Mexicaines au Mexique). Saint-Biey. An illustrated sketch of a cotton, a cigarette and a woolen factory, under the direction of French engineers. 2000 w. Revue Technique—June 25, 1900. No. 35832 D.

Paris Exposition.

Mechanical Engineering Exhibits at the Paris Exposition. Illustrates and describes some of the interesting exhibits, with comments. 3600 w. Eng News—Aug. 16, 1900. No. 35964.

Textile.

Machines for Textile Industries at the Paris Exposition (Die Weltausstellung in Paris 1900. Die Arbeitsmaschinen für die Textil-industrie). G. Rohn. An extended review of the machines used in textile industries, exhibited at Paris. Serial. 1st part. 7000 w. Zeitschr d Ver Deutscher Ing—July 28, 1900. No. 35871 D.

Weights.

The Inidikil System. A. Lincoln Hyde. Explains a decimal system of weights and measures for the English speaking people. 4300 w. Jour Assn of Engng Socs—July, 1900. No. 35984 C.

MINING AND METALLURGY

COAL AND COKE.

Australasia.

Australasian Coal. Concerning the advance in price and the output. 1200 w. Engng—Aug. 3, 1900. No. 35906 A.

British Coal Fields.

The British Coal Fields and Their Exhaustion (Die Britischen Kohlenlager und ihre Erschöpfung). Dr. Tübben. An abstract of a French book by Ed. Lazé, in which it is estimated that the British coal fields will be exhausted in the not very distant future. With an estimate of the coal supply of the other countries of the world. 4200 w. 3 plates. Glückauf—July 21, 1900. No. 35897 B.

Coke Ovens.

Welsh Coke Ovens. A brief description of a form of oven used in West Virginia in place of beehive ovens. 500 w. Mines & Min—Aug., 1900. No. 35684 C.

Coking.

Coking Plant of the Durham Coal & Coke Co. A. W. Evans. Illustrated description of a plant on Lookout Mountain, Georgia. 1300 w. Mines & Min—Sept., 1900. No. 36131 C.

Gob Workings.

Draining Gas from Gob Workings. Charles Connor. Considers the relative advantages of force and exhaust pans for this purpose. Also discussion. 7000 w. Mines & Min—Sept., 1900. No. 36135 C.

Inclines.

Transportation on Inclines. Edward H. Coxe. Describes the methods of getting coal down the mountain from mine to tipple in West Virginia. 1200 w. Mines & Min—Aug., 1900. No. 35683 C.

Kebao.

The Collieries of Kebao, Tonking. Brief account of this island and its coal

deposits. Map. 1800 w. Ir & Coal Trds Rev—Aug. 3, 1900. No. 35798 A.

Mining Machinery.

Electric Mining Machinery in the British Collieries. Sydney F. Walker. Mr. Walker's second paper discusses the details of lighting, signaling and working of surface plant, with many illustrations of most recent devices. 4000 w. Engineering Magazine—September, 1900. No. 36170 B.

New Method.

Rib Drawing with Machines. W. S. Gresley. Illustrates and describes a proposed new method of mining coal by the use of longwall undercutting machines for taking out the rib. 2200 w. Mines & Min—Sept., 1900. No. 36138 C.

Paris Exhibition.

Blanzy Colliery at the Paris Exhibition. A description of the extensive exhibit of a half-size model of winding drum with tangential arms. 2200 w. Col Guard—Aug. 17, 1900. No. 36115 A.

Pictou, Col.

Coal Mines of Pictou. Frank Meade A description of the mines of the Colorado Fuel & Iron Co., the methods of operation, and the geological formation. Ill. 2800 w. Mines & Min—Aug., 1900. No. 35679 C.

South Wales.

The Collieries of the Ebbw-Vale Company. Describes the characteristics of this coal field, and gives illustrated description of its various collieries. 3000 w. Ir & Coal Trds Rev—July 27, 1900. No. 35728 A.

Ventilation.

Resistance Opposed to Air-Currents by Wickets. Paul Petit. From a paper prepared for the International Congress at Paris. Considers the theory of the wicket, method of experimenting, and the results obtained. 2700 w. Col Guard—Aug. 17. 1900. No. 36116 A.

COPPER.

Deposits.

Glassford Creek Copper Mines. An account of the discovery of a rich deposit in Queensland, Aust. 1700 w. Aust Min Stand—July 12, 1900. No. 36020 B.

Lake Superior.

Lake Superior Copper Mines. H. J. Stevens. Discusses why the copper output does not respond as readily as the iron to an increase or decrease in price. 1200 w. Mines & Min—Sept., 1900. No. 36136 C.

New South Wales.

Copper Mining in New South Wales. Describes the work in the Mount Hope district. 1800 w. Aust Min Stand—June 21, 1900. No. 35695 B.

Supply.

Copper Supplies and Consumption. Editorial comment on copper prospects. 1400 w. Engng—Aug. 10, 1900. No. 36004 A.

United States.

The Great Copper Mines of the United States. From the *N. Y. Sun*. Interesting information concerning the great copper producing districts and their output. 800 w. Elec Rev, N. Y.—Aug. 22, 1900. No. 36055.

GOLD AND SILVER.

Alaska.

The Yukon and Nome Gold Regions. S. C. Dunham. A full account of these two gold fields and a comparison of the conditions and values. 20400 w. Bul Dept of Labor. July, 1900. No. 35916 D.

Assays.

Remarks on Assays and Samples. W. F. Robertson. Suggestions for securing accuracy in sampling and assaying. 1700 w. B. C. Min Rec—Aug., 1900. No. 35764 B.

Australasia.

The Australian Gold Yield. Reviews the production of the first half of the current year, reporting it as not realizing expectations. 1000 w. Aust Min Stand—July 12, 1900. No. 36019 B.

British Columbia.

Camp McKinney and Its Mines. Donald A. Ross. An illustrated account of the various mines and the development. 4000 w. B. C. Min Rec—Aug., 1900. No. 35762 B.

Howe Sound Division, New Westminster Mining District. W. M. Brewer. Report of personal examination made recently. 1500 w. Eng & Min Jour—Aug. 18, 1900. No. 35979.

California.

The Empire Mines, Past and Present. George W. Starr. Historical review. Ill. 1100 w. Min & Sci Pr—Aug. 4, 1900. Serial. 1st part. No. 35784.

Deposits.

Copper Deposits of the Ajo Basin, Gila Basin, Arizona. Arthur Lakes. A description of the country and its facilities in regard to the supply of fuel and water and timber necessary to operate the mines in that region. The large amount of mineral and difficulties of exploiting. 4500 w. Mines & Min—Aug., 1900. No. 35685 C.

Dredging.

Gold Dredging in British Columbia. R. Luid Watson. An illustrated description of the dredging plants and methods of operation used on the Fraser River. 2500 w. Mines & Min—Aug., 1900. No. 35682 C.

Notes on Gold Dredging. J. W. H. Piper. Read before the N. S. W. Chamber of Mines. An illustrated article, showing the great advantage of the bucket dredge as a gold producer. 1700 w. B. C. Min Rec—Aug., 1900. No. 35763 B.

Notes on Gold Dredging in New Zealand and New South Wales. J. W. H. Piper. Read at meeting of N. S. W. Chamber of Mines. Showing the immense advantage of the bucket dredge as a gold-producer. 1700 w. N. Z. Mines Rec—June 16, 1900. No. 35648 B.

Spoon and Grab Dredges. J. W. Jaffray. Read before the N. S. W. Chamber of Mines. Discusses the efficiency and economy of these dredges. 2800 w. Aust Min Stand—July 28, 1900. No. 35698 B.

Nevada.

The Ely Mining District, Nevada. Fred D. Smith. Describes a gold district of much promise. 1000 w. Eng & Min Jour—Aug. 25, 1900. No. 36076.

Newfoundland.

Notes on the Mineral Deposits of Newfoundland. William Scott. Reports briefly concerning the various minerals found and gives illustrations of the mines. 2100 w. Eng & Min Jour—Aug. 11, 1900. No. 35935.

New Mexico.

The Cochiti District, New Mexico. W. C. Wynkoop. Illustrates and describes this district, giving report of the mines, their output, value, etc. 2200 w. Eng & Min Jour—Aug. 25, 1900. No. 36075.

Nova Scotia.

The Metal Mines of Nova Scotia. Notes condensed from a monograph on the "Ores of Nova Scotia," by E. Gilpin, Jr. 2500 w. Eng & Min Jour—Aug. 11, 1900. No. 35936.

Oregon.

Ore Deposits in the Cracker Creek District, Oregon. T. L. Lammers. An account of the development of both placer and quartz mining, and the character of the deposits. 1300 w. Eng & Min Jour—Aug. 11, 1900. No. 35937.

Smelting.

Notes on Lead Smelting and Gold and Silver Refining. Malvern W. Iles. On the cost of smelting and refining at the Globe Works, Denver, Col. 2000 w. Eng & Min Jour—Aug. 18, 1900. No. 35976.

Silver Smelting in Mexico. Otto H. Hahn. Condensed extract from paper before the London Inst. of Min. & Met. A criticism of the method in operation at Smelter No. 3, of M. Guggenheim's Sons at Monterey, Mexico. 2000 w. Min & Sci Pr—July 28, 1900. Serial. 1st part. No. 35667.

South Carolina.

The Haile Gold Mines of South Carolina. Arthur Lakes. An illustrated account of some striking peculiarities in regard to the ore bodies as compared with most western deposits. 3000 w. Mines & Min—Sept., 1900. No. 36134 C.

IRON AND STEEL.

Basic Steel.

On the Present Condition of the Manufacture of Basic Steel and Its Influence Upon That of Puddled Iron. M. G. Rocour. Abstract of a paper read before the Paris Min. and Met. Cong. Describes the present condition of this industry, and discusses the future outlook. 1500 w. Ir & Coal Trds Rev—July 27, 1900. No. 35730 A.

Blast Furnaces.

A New Method of Constructing Blast Furnaces. F. Burgers. Paper read before the Verein Deutscher Eisenhuttenleute. Describes a new system in which the shaft of the furnace is made of iron instead of fire-brick. Ill. 1800 w. Ir & Coal Trds Rev—July 27, 1900. No. 35727 A.

British Iron.

Glimpses of the British Iron Industry. An interesting review. 3000 w. Ir Age—Aug. 9, 1900. Serial. 1st part. No. 35922.

Corrosion.

The Relative Corrosion of Wrought Iron, Soft Steel, and Nickel Steel. Henry M. Howe. Abstract of paper read at International Cong. on Methods of Testing the Materials of Construction. 1500 w. Eng & Min Jour—Aug. 18, 1900. No. 35978.

Crystallography.

On the Crystallography of Iron. F. Osmond. A study of the crystallography of gamma-iron with interesting illustrations. 12500 w. Metallographist—July, 1900. Serial. 1st part. No. 35960 E.

Direct Process.

The Direct Production of Iron with a Definite Percentage of Carbon (Directe Eisengewinnung mit Bestimmtem Kohlenstoffgehalt). John Landin. A description of a process for producing iron direct from the ore, involving the preparation of briquettes containing ore, coal, lime and other ingredients. 1000 w. Oest Zeitschr f Berg u Hüttenwesen—July 14, 1900. No. 36150 B.

New Zealand.

Iron Ores and Lands of New Zealand. James Hector. Notes from the Handbook of New Zealand, 1886. 1800 w. N. Z. Mines Rec—July 16, 1900. No. 36139 B.

Open-Hearth.

Charging Apparatus for Martin Furnaces (Beschickungsvorrichtung für Mar-

tinöfen). An illustrated account of electrically driven carriage and charging machinery. 800 w. Stahl und Eisen—July 15, 1900. No. 35889 D.

Open-Hearth Steel Plant of the Alabama Steel & Shipbuilding Co., at Ensley, Ala. An illustrated detailed description of this important plant. 3200 w. Ir Trd Rev—Aug. 23, 1900. No. 36052.

Paris Exhibition.

Iron and Steel at the Paris Exhibition. Reviews the exhibits of the various countries. Ill. 32000 w. Ir & Coal Trds Rev—Aug. 10, 1900. No. 36008 A.

Rail Steel.

Rail Steel. The greater part of the reports for all countries, excepting the United States, at the International Railroad Congress. 2000 w. R R Gaz—Aug. 10, 1900. No. 35953.

Rolling Mills.

American Rolling Mills (Amerikanische Walzwerksanlagen). P. Eyermann. An illustrated description of some of the mills at Duquesne and Homestead, Pa., and the methods used there. 4000 w. Stahl und Eisen—July 15, 1900. No. 35887 D.

Specifications.

See Mechanical Engineering, Materials.

Steel Processes.

Recent Progess in Methods of Producing Steel (Die Neueren Fortschritte in der Flusseisenerzeugung). Fritz Lürmann, Jr. A paper before the Verein Deutscher Eisenhüttenleute, giving an illustrated account of improvements in converter and open-hearth processes; with the ensuing discussion. 11000 w. Stahl und Eisen—Aug. 1, 1900. No. 35890 D.

Sweden.

A Description of Some Little Known Iron Ore Deposits in Northern Sweden (Bescreibung einiger bisher wenig bekannter Erzvorkommen in dem Erzrevier von Jukkasjärvi (Schweden) und Umgebung). From an article by Walfr. Peterson in *Jernkontorets Annaler*, giving an account of the iron ores in the extreme north of Sweden. Serial. 2 parts. 2000 w. Glückauf—July 21, Aug. 4, 1900. No. 35899 each B.

Tool Steel.

See Mechanical Engineering, Machine Works and Foundries.

MINING.

Accidents.

Accidents in Coal Mines. Thomas K. Adams. A comparison between the coal production and number of accidents and their causes in different states and countries. 3800 w. Mines & Min—Sept., 1900. No. 36133 C.

Air-Pipes.

Loss of Load in Air-Pipes. Paul Petit. From a paper prepared for the International Cong. of Min. & Met. at Paris. Describes the mode of experimenting and gives the conclusions reached. Ill. 3500 w. Col Guard—Aug. 3, 1900. No. 35900 A.

Analysis.

Micro-Chemical Methods in Metallurgical Analysis. An outline of some microchemical reactions, and of methods of research in this new branch of chemistry. Ill. 4000 w. Col Guard—Aug. 10, 1900. No. 36011 A.

Fans.

The Practicable Scope of the Equivalent Orifice Theory. H. W. Halbaum. Discusses the work and results of M. Murgue in its application to fan tests. 4000 w. Col Guard—Aug. 17, 1900. No. 36114 A.

Fire Damp.

The Electric Spark in Coal Mines. Examines the question of the passage in mines where inflammable gas may be present, with the view of enabling mine managers to form an impartial opinion. Ill. 3200 w. Col Guard—July 27, 1900. No. 35712 A.

Leaks.

The Prevention of Leaks in Mines. L. C. Morganroth. On the importance of system and attention to little things. 1500 w. Mines & Min—Aug., 1900. No. 35681 C.

Mining Machinery.

See Coal and Coke.

Peru.

Peru's Mining Industries. H. L. Geissel. Facts in regard to the various ores and minerals and the extent to which they have been exploited. 2800 w. Mines & Min—Sept., 1900. No. 36137 C.

Pneumatophore.

The Practical Use of the Pneumatophore (Die Benutzung des Pneumatophors im Ernstfall). H. Lüthgen. An account of a mining accident, and the use of an apparatus containing oxygen, which is used for breathing when in an atmosphere of dangerous gases. 1500 w. 1 plate. Glückauf—July 14, 1900. No. 35896 B.

Pumping Engine.

The Kaselowsky Pumping Engine at Westphalian Collieries. Abstracted from a paper by C. François, in the *Revue Universelle des Mines*. Illustrated description of the system used. 800 w. Col Guard—Aug. 17, 1900. No. 36117 A.

Shaft Lining.

The Manufacture of Linings for Mine Shafts, at Garcy, France (Etude sur la Fabrication des Cuvelages de Puits de

Mines à Garcy, Meurthe-et-Moselle). E. Clère. An illustrated description of the manufacture of cast iron linings for shafts, in sections, with lead joints. 2400 w. 1 plate. Mem d l Soc d Ing Civils de France—No. 10, 1900. No. 35843 G.

Stores.

Mine Stores. F. Danvers Power. Abstract of paper read before the Aust. Inst. of Min. Engs. Suggestions for the ordering and distributing of mining stores, and the keeping of the accounts. 2500 w. Ir & Coal Trds Rev—Aug. 17, 1900. No. 36107 A.

Timbering.

Mine Timbering. David J. Evans. Read before the Indiana Min. Inst. Presents various ways of cutting and placing timbers to secure the best results. 1600 w. Mines & Min—Aug., 1900. No. 35688 C.

Wages.

Miners' Wages in the Pennsylvania Anthracite Mines. Concerning the changed conditions, explaining why many mines have been operated at a loss, and features of the wage scale. 1500 w. Eng & Min Jour—Aug. 25, 1900. No. 36074.

MISCELLANY.

Alloys.

Magnalium. Translated from *Neueste Erfindungen und Erfahrungen.* An interesting description of a new alloy, composed of aluminum and magnesium. 1800 w. Ir Age—Aug. 23, 1900. No. 36035.

Aluminum.

The Generation of Intense Heat Through the Combustion of Aluminum. S. B. Archdeacon. Describes the process, based on the affinity of aluminum and oxygen, noting some of its applications. Ill. 3600 w. Eng & Min Jour—Aug. 25, 1900. No. 36077.

Carborundum.

Carborundum. L. J. Gray. An account of the discovery, the development of the manufacture, the remarkable properties, etc. Ill. 2000 w. Foundry—Aug., 1900. No. 35674.

Congress.

The Congress of Mines and Metallurgy at the Paris Exposition (Congrès des Mines et de la Metallurgie). Gérard Lavergne. An abstract of the proceedings of this congress, held June 18 to 23. 3500 w. Génie Civil—Aug. 4, 1900. No. 35885 D.

Cornwall.

The Decaying Mining Industries of Cornwall. From the annual report of J. S. Martin, inspector. An account of present conditions, with tables showing the fluctuations in the price of tin since 1850. 1900 w. Ir & Coal Trds Rev—Aug. 10, 1900. No. 36007 A.

Lead.

Note on the Metallurgy of Lead in Murcia, Spain (Note sur la Metallurgie du Plomb dans la Province de Murcie, Espagne). P. Jannettaz. A general description of the region, the lead ores, galena particularly, and their metallurgical treatment. 2000 w. Mem d l Soc d Ing Civils de France—No. 12, 1900. No. 35848 G.

Leadville.

The Fourth Era of the Leadville Mining District. Thomas Tonge. A review of the successive stages of the Leadville district with especial reference to the development, not only of gold and silver, but also of copper, iron, zinc, and bismuth. 4000 w. Engineering Magazine—Sept., 1900. No. 36173 B.

Lead-Zinc.

The Lead and Zinc Industry of Southwest Missouri. F. W. Draper. Read before the Ap. Sci. Soc. of McGill Univ. Describes the deposits, discussing their origin, and the methods of mining and preparation for market. 2100 w. Can Engr—Aug., 1900. No. 35786.

Mexico.

Mines of Velardena, Mexico. Ernest E. Payne. A history and illustrated description of some little known, but productive, mines, which have been worked for centuries. 1400 w. Mines & Min—Sept., 1900. No. 36132 C.

New South Wales.

Metals and Minerals of New South Wales. J. E. Carne. Report on the mineralogical deposits occurring in the high tableland between Tumut and Kiandra. 2200 w. Aust Min Stand—June 21, 1900. No. 35096 B.

Mines and Minerals of New South Wales. W. H. J. Slee. On the resources and development of the Inverell and Tingha districts. 2600 w. Aust Min Stand—June 28, 1900. No. 35697 B.

Ores.

Magnetic Preparation of Ores. M. Smits. From a paper prepared for the International Congress at Paris. An illustrated description of the Wetherill process. 1700 w. Col Guard—July 27, 1900. No. 35713 A.

Paris Exhibition.

Mechanical Preparation Plant at the Paris Exhibition. Illustrated description of preparation appliances shown in the French section, for crushing, sizing, etc. 2200 w. Col Guard—Aug. 10, 1900. No. 36013 A.

Petroleum.

The Distribution and Production of Mineral Oil (Ueber die Verbreitung und die Produktion des Erdöls unter beson-

derer Berücksichtigung der für Deutschland Wichtigsten Produktionsgebiete). Prof. Oebbeke. Abstract of an address before the Munich Polytechnischer Verein, in which the subject is treated generally, and particular attention called to the Carpathian oil fields, in Central Europe. 2400 w. Glückauf—July 28, 1900. No. 35898 B.

Quarrying.

Quarrying by the Helicoidal Wire. N. Pellati. From a paper prepared for the International Congress, at Paris. Describes the method and its advantages. 1000 w. Col Guard—Aug. 17, 1900. No. 36118 A.

Ruby Mines.

The Burma Ruby Mines. An account of the work at these mines, which are now working on a paying basis. 1000 w. Eng & Min Jour—Aug. 18, 1900. No. 35977.

Salt Lake.

Great Salt Lake and Its Waters. Don Maguire. A history of the early exploration that led to its discovery, and an account of an expedition upon it in 1891. 6500 w. Mines & Min—Aug., 1900. No. 35680 C.

Siberia.

Mineral and Agricultural Resources of Siberia. Translation from a recently published book by Baron de Batz, giving information about the gold-bearing strata, climate, etc. 2800 w. U. S. Cons Repts, No. 808—Aug. 15, 1900. No. 35917 D.

Tin.

Cornish Tin Mining. Considers reasons why this industry has not revived with the rise in the price of this metal. 1800 w. Engr, Lond—Aug. 17, 1900. No. 36-113 A.

Zinc.

Improvements in the Metallurgy of Zinc. J. Ohly. Reviews the past methods and describes the improved process invented by Dr. Lungwitz and Dr. Schupphaus. 1700 w. Min Rept—Aug. 2, 1900. No. 35744.

Researches on the Influence of the Degree of Desulphuration of Blende upon the Yield of Zinc (Recherches sur l'Influence du Degré de Désulfuration des Blendes sur le Rendement en Zinc à la Réduction). Eugène Prost. An account of experiments which show the importance of care in roasting zinc sulphides. 2000 w. Rev Universelle des Mines—March, 1900. No. 35867 F.

The Metallurgy of Zinc. H. Van F. Furman. Discusses the physical and chemical properties, ores, methods of reducing, dry and wet processes, etc. 5800 w. Mines & Min—Aug., 1900. Serial. 1st part. No. 35687 C.

Zinc Smelting at Cañon City. Illustrates and describes an interesting plant for ore reduction. 1300 w. Min Rept—Aug. 23, 1900. No. 36129.

RAILWAY AFFAIRS

CONDUCTING TRANSPORTATION.

Accidents.

Train Accidents in the United States in June. Detailed list and classified summary. 4500 w. R. R. Gaz—Aug. 17, 1900. No. 35970.

Madagascar.

Ways of Communication and Methods of Transportation in Madagascar (Commission des Etudes Coloniales. Voies de Communication et Moyens de Transport à Madagascar). J. J. Marié. A. general review of present systems on the island and proposed improvements, with maps. 10000 w. 1 plate. Mem d l Soc d Ing Civils de France—No. 9, 1900. No. 35-842 G.

Southern Railway.

Evolution of the Southern Railway. An account of the progress during the last six years. 1800 w. R R Gaz—Aug. 17, 1900. No. 35974.

Tramp Problem.

Railroad Police Organization and the Tramp Problem. Josiah Flynt. Read before the Cent. Assn. of R. R. Officers. An account of the great number of tramps continually on the railroads, and the history of the police service in vogue on one important railroad. 3500 w. St. Louis Ry Club—Aug. 10, 1900. No. 36092.

FINANCIAL.

American Railroads.

American Railroads. George H. Daniels. An interesting discussion of their relation to commercial, industrial and agricultural interests. 5000 w. St. Louis Ry Club—Aug. 10, 1900. No. 36091.

MOTIVE POWER AND EQUIPMENT.

Air-Brake.

Reports on the Lipkowski Compressed-Air Brake (Rapports au Comité de l'Exploitation Technique des Chemins de Fer sur le Frein à Air Comprimé, Système Lipkowski). E. Vicaire. French official reports, giving the results of trials on French railways, which were satisfactory,

on the whole. 8000 w. Ann d Ponts et Chaussées—1st quarter, 1900. No. 35860 E + F.

Compartment Car.

First-Class Compartment Car—Paris, Lyons & Mediterranean Railway. Illustrations with brief description. 400 w. R R Car Jour—Aug., 1900. No. 35921.

Dining Cars.

Southern Railway Dining Cars. Brief description, with plan. 900 w. Ry Age—Aug. 3, 1900. No. 35742.

Dining Trains.

New Corridor Dining Trains on East Coast Route to Scotland. Charles Rous-Marten. Describes the train and the trial trip. 2000 w. Engr, Lond—Aug. 3, 1900. No. 35913 A.

Draft Gear.

The Sessions-Standard Friction Draft Gear. Illustrated description with report of tests. 1400 w. R R Gaz—Aug. 17, 1900. No. 35972.

Draft Rigging Test.

Interesting Draft Rigging Test. An account of tests made at Lima, O., on draft rigging, devised by Clement F. Street. Ill. 2200 w. Ry & Engng Rev—Aug. 11, 1900. No. 35927.

Feed Water.

On "Pure Water for Locomotives by Evaporation." C. Herschel Koyl. Discusses articles bearing on this subject and favors the purifying of the water by chemical means as far cheaper. Ill. 1500 w. R R Gaz—Aug. 17, 1900. No. 35971.

Firebox.

Problems the Wide Firebox Solves. J. S. S. Fulton. On the merits of large grates. 1500 w. Am Engr & R R Jour—Aug., 1900. No. 35643 C.

Heating.

The Heating of Railway Carriages. Discusses the details in connection with the distribution along the length of the train when steam heating is used. 2200 w. Engr, Lond—Aug. 3, 1900. No. 35909 A.

Locomotives.

Austrian Locomotives at the Paris Exhibition. Illustrates and describes the exhibit of the Actien-Gesellschaft der Locomotiv-Fabrik, Wiener-Neustadt. 800 w. Engng—Aug. 17, 1900. No. 36103 A.

Boiler and Frames—Twelve-Wheel Freight Locomotive. Illustrates and describes these features in a large engine for the Illinois Central R. R. 600 w. Am Engr & R R Jour—Aug., 1900. No. 35642 C.

Consolidation Locomotives for the Rio Grande Western Ry. Illustrated detailed description of a large and powerful engine. 1000 w. Eng News—Aug. 30, 1900. No. 36146.

Four-Cylinder Locomotive. Illustrated detailed description of a fine engine in service on the Glasgow & South-Western Ry. 600 w. Engng—Aug. 10, 1900. No. 36003 A.

Four-Wheel Coupled Locomotive at the Paris Exposition. Illustrated description of an interesting engine, built for drawing heavy loads at a relatively high speed for long distances without stopping. 1000 w. Engng—Aug. 3, 1900. No. 35907 A.

Locomotive Exhibits at the Paris Exposition. Charles Rous-Marten. An expert review of the leading exhibits, showing the principal tendencies of modern practice. Serial. Part I. 3000 w. Engineering Magazine—Sept., 1900. No. 36-168 B.

Some of the Recent Passenger Locomotives of the Pennsylvania Railroad. Illustrates 10-wheel and 8-wheel locomotives, giving information concerning them. 300 w. R R Gaz—Aug. 10, 1900. No. 35950.

Ten-Wheel Passenger Locomotives. Brief illustrated description of one of the ten locomotives built for the Finland State Railways. 350 w. Am Engr & R R Jour—Aug., 1900. No. 35644 C.

Yard Locomotive, Central London Railway. Sectional drawings with brief description. 400 w. Engr, Lond—Aug. 3, 1900. No. 35911 A.

Locomotive Works.

See Mechanical Engineering, Machine Works and Foundries.

Sleeping Car.

The First Japanese Sleeping Car. Willard C. Tyler. Views of a car built in Japan and put in service on the Sanyo Ry., with description. 600 w. Ry & Engng Rev—Aug. 11, 1900. No. 35926.

Snow Plows.

Machine Snow Plows on the Colorado Midland Ry. Gives the results on this road in trials of the two kinds of excavators used in this country. 1500 w. Eng News—Aug. 23, 1900. No. 36066.

Standards.

Standards of, and Practices Approved by, the Master Mechanics' Association. Information extracted from the report presented at the Saratoga convention. 2000 w. Ry Mas Mech—Aug., 1900. No. 35777.

Steel Cars.

Pressed Steel Cars for France. Illustrations showing the construction and general dimensions of 100 flat-bottom gondola cars being shipped to the Paris, Lyons & Mediterranean Railroad Co., of France. 800 w. R R Gaz—Aug. 10, 1900. No. 35951.

Summers' 100,000 lbs. Capacity Steel Hopper Car. An illustrated detailed description of a new design. 1000 w. Ry & Engng Rev—Aug. 25, 1900. No. 66102.

Superheating.

Super-Heated Water Motor for Railroad Traction. An illustrated explanation of a system which is being tested on the New York & Putnam Railway. 1900 w. Sci Am—Aug. 25, 1900. No. 36046.

Test Car.

Test Car of the Illinois Central Railroad and the Railway Mechanical Engineering Department of the University of Illinois. Edward C. Schmidt. Illustrated description of the car and its equipment. Designed for general railroad experimental work. 1200 w. Am Engr & R R Jour—Aug., 1900. No. 35641 C.

Train Lighting.

Electricity Versus Gas for Train Lighting. Alton D. Adams. Favors electricity, considering it safer and less costly. 1600 w. W Elect'n—Aug. 11, 1900. No. 35941.

Valve.

A New Triple Valve. Illustrated description of a new triple valve and high-speed brake attachments, patented by M. W. Hibbard. 1200 w. R R Gaz—Aug. 10, 1900. No. 35952.

NEW PROJECTS.

Extension.

The Lanarkshire and Ayrshire Railway Extension. Abridged from the *Glasgow Evening Citizen*. Describes a new extension to expedite mineral traffic. 1500 w. Transport—Aug. 3, 1900. No. 35793 A.

Great Northern.

Great Northern Railway—New Railway at Nottingham. R. F. Bennett. An account of an expensive connecting line of first-class character. Ill. 2400 w. Engr, Lond—Aug. 17, 1900. Serial. 1st part. No. 36112 A.

Improvements.

Improvements on the Cincinnati Southern Ry. Illustrates and describes the work of building a new line around tunnel No. 27, and other improvements. 1000 w. Ry & Engng Rev—Aug. 18, 1900. No. 36023.

India.

Indian Railway Enterprise. Editorial on recent progress and improvement. 1000 w. Engng—Aug. 17, 1900. No. 36105 A.

Mexico.

Railway Contract in Mexico. A copy of the contract relating to the Tehuantepec Railroad and the ports of Coatzacoalcos and Salina Cruz. 1100 w. U. S. Cons Repts, No. 805—Aug. 11, 1900. No. 35761.

Panama.

Concerning the Panama Railroad. George Hebard Paine. Describes the road and its equipment, and gives related information. 1600 w. R R Gaz—Aug. 17, 1900. No. 35969.

Russo-Chinese.

A New Russo-Chinese Railroad Scheme —Samarkand to Hankow. From the Moscow *Russian Gazette*. Concerning a road into the interior of China for the benefit of Russian foreign trade with the East. 700 w. R R Gaz—Aug. 10, 1900. No. 35954.

Siberian Railway.

The Siberian Railway. Interesting details taken from the survey drawn up for the Paris Exhibition by the Imperial Commission. Map. 1500 w. Engr, Lond —Aug. 3, 1900. No. 35915 A.

Spain.

Railways in Spain. Information concerning the principal corporations, the difficulties in the way of construction, the projected lines, equipment, etc. 1500 w. U. S. Cons Repts, No. 801—Aug. 8, 1900. No. 35760 D.

Transbaikal.

The Transbaikal Hei-lun-Zagan Railway. Interesting details relating to this section, and some of the problems met. 1800 w. Engng—Aug. 10, 1900. No. 36005 A.

PERMANENT WAY AND FIXTURES.

Gates.

Railway Crossing Gates with Pipe Connections. Illustrates and describes a gate operated by pipe connections and levers similar to those of an interlocking plant. 450 w. Eng News—Aug. 23, 1900. No. 36070.

Grade Crossings.

Highway Grade Crossing Alarms. J. S. Evans. Read before the Assn. of R. R. Tel. Supts. Discusses the protection by automatic alarms, the reliability, cost, etc. 1200 w. Eng News—Aug. 30, 1900. No. 36149.

Mileage.

The Great Railway Systems—Present Rank by Mileage. Gives a tabulated list of all railway companies of the United States and Canada, which control over 2,000 miles of lines, with related information. 1100 w. Ry Age—Aug. 3, 1900. No. 35741.

N. Y. Central.

Permanent Way of the New York Central. Diagrams as condensed from records made by Mr. Dudley's Apparatus, with remarks. 1100 w. R R Gaz—Aug. 3, 1900. No. 35671.

The New York Central's Improvements

at Weehawken. Plans of the proposed reorganization of a great terminal freight yard, with several additional piers, and eventually a new grain elevator. 1000 w. Ry Age—Aug. 10, 1900. No. 35919.

Rail Fastening.

The Albert Collet System of Fastening Rails to Cross Ties (Rapports de M. Ed. Sauvage, sur les Attaches de Rails de M. A. Collet). A report on methods and tools used. A hardwood treenail is screwed into the tie and the fastening screw is screwed into the treenail. Well illustrated. 2000 w. Bull d l Soc d'Encouragement—June 30, 1900. No. 35864 G.

Rails.

Recent Practice in Rails. An informal discussion by Robert W. Hunt and A. L. Colby. 9500 w. Pro Am Soc of Civ Engs—Aug., 1900. No. 36098 E.

Some Peculiarities of Steel Rails. Photographic examination of sections etched by dilute sulphuric acid, as given in an appendix to the report of the committee appointed by the British Board of Trade. 600 w. Ir & Coal Trds Rev—Aug. 3, 1900. No. 35799 A.

The Qualities and Life of Rails. Synopsis of the report of a committee appointed by the British Board of Trade to inquire into this question, with brief comment. 2400 w. R R Gaz—Aug. 3, 1900. No. 35672.

The Life of Steel Rails. An article giving results of experience. Discusses tramways, pavements, railways, and gives a comparison of methods of laying tramway and railway tracks. 5400 w. Engr, Lond—July 27, 1900. No. 35737 A.

Railway Bridges.

See Civil Engineering, Bridges.

Signals.

The Timmis-Lavezzari Automatic Electric Signal System (Signaux Electriques Automatiques Système Timmis-Lavezzari). A. Lavezzari. An illustrated description of the system as applied on the electric railroad at the Paris Exposition of 1900. 1600 w. Mem d l Soc d Ing Civils de France—No. 8, 1900. No. 35841 G.

Union Automatic Signals on the Lackawanna. A diagram showing the arrangement of signals. The signals are semaphores, worked by electric motors. 600 w. R R Gaz—Aug. 10, 1900. No. 35949.

Tie Plates.

A Tie-Plate Setting and Surfacing Gage. Illustrated description of a tool for securing accurate work and its time record. 900 w. Eng News—Aug. 2, 1900. No. 35692.

Track Construction.

Standards of Track Construction on American Railways. Gives tabulated statements representing the standard practice now in force in the United States, Canada and Mexico, with other information, and editorial comment. 8000 w. Eng News—Aug. 30, 1900. No. 36144.

Track Inspection.

A Graphical Registering Method for Railway Track Inspection (Méthode Graphique pour la Reconnaissance et la Vérification du Tracé des Voies de Chemins de Fer). M. Desdouits. An illustrated description of work with a pendulum registering apparatus, which records all the features of the track when run over it on any kind of vehicle. 8000 w. 2 plates. Ann d Ponts et Chaussées—4th quarter, 1899. No. 35852 E + F.

Tunnels.

See Civil Engineering, Construction.

TRAFFIC.

American Railways.

Passenger Traffic and Passenger Profits on American Railways. Editorial discussion of the difficulties in conducting passenger traffic on a paying basis. 3000 w. Eng News—Aug. 16, 1900. No. 35965.

STREET AND ELECTRIC TRAMWAYS

Brakes.

An Electric Brake for Trailer Cars (Elektrische Bremse für Anhängewagen). Dr. A. Krebs. An illustrated description of an electric brake of simple mechanical construction, made by the Allgemeine Elektricitäts Gesellschaft. 500 w. Elektrotech Zeitschr—July 19, 1900. No. 35804 B.

Tests of Street Car Brakes by the New York Railroad Commission. Descriptions of the brakes tested which met the requirements. 4800 w. Eng News—Aug. 2, 1900. No. 35691.

Tests of Street Car Brakes in New York. Editorial pointing out some of the defects of the tests and records made by the New York Railroad Commission. 1100 w. R R Gaz—Aug. 10, 1900. No. 35955.

City Traffic.

Grounded Cars and Dead Rails. E. C. Parham. Discusses these troubles and the way to start the car without danger. 1000 w. Am Elect'n—Aug., 1900. No. 35666.

Combined System.

The Bois de Boulogne Combined Trolley and Surface Contact Tramway. Illustrates and describes the line and its operation. 2000 w. Elec Rev, Lond—Aug. 17, 1900. No. 36125 A.

Compressed Air.

Compressed Air Cars in New York. An account of the change being made in the motors of the Twenty-eighth and Twenty-ninth street lines in New York City, explaining the reason of the change. Ill. 2500 w. St Ry Jour—Aug. 4, 1900. No. 35775 D.

Conduit Roads.

Note on American Electric Conduit Tramways (Note sur les Tramways Electriques Americains à Prise de Courant par Caniveau Souterrain). M. Mesnager. A description of the New York and Washington conduit roads, with map, and illustrations of yokes, etc. 6000 w. 1 plate. Ann d Ponts et Chaussées—4th quarter, 1899. No. 35850 E + F.

Controller.

The Auvert Compressed-Air Motor for Controlling Electric Trains (Servo-Moteur Auvert). Ch. Baudry. An illustrated description of a system of operating the individual electric controllers on the cars of an electric train, by a compressed-air master motor at one point and secondary motors on the cars. 2200 w. 1 plate. Mem d l Soc d Ing Civils de France—No. 8, 1900. No. 35840 G.

Electrolysis.

Electrolysis in Providence, R. I. Illustrated description of an investigation by A. A. Knudson, one of the cuts showing the effect of electrolysis on the interior of pipes. 3400 w. Eng Rec—Aug. 4, 1900. No. 35722.

English Line.

Description of the Blackpool and Fleetwood Tramroad and Generating Station. Tom. G. Lumb. Describes the permanent way, distributing system and rolling-stock. 3300 w. Elec Engr, Lond—Aug. 10, 1900. No. 36018 A.

English Railway.

Electric Railway in Birmingham. An account of difficulties in tramway matters, and of an experimental overhead electric trolley system. 1500 w. U. S. Cons Repts, No. 815—Aug. 23, 1900. No. 36050 D.

Exhibition.

The International Tramways and Light Railways Exhibition. Complete illustrated description of the exhibition held at the Royal Agricultural Hall, Islington, London, N., from June 22 to July 4. 25000 w. Tram & Ry Wld—Aug. 9, 1900. No. 36178 A.

Flanges.

Wheel Flanges and Rail Grooves. William Glenny Keagey. Discussion of the causes of the breaking of wheel flanges, and the remedy. Ill. 1000 w. Tram & Ry Wld—Aug. 9, 1900. No. 36177 A.

Glasgow.

The Electric Equipment of Glasgow Tramways. An illustrated detailed description of this extensive three-phase system. 6500 w. Tram & Ry Wld—Aug. 9, 1900. No. 36175 A.

Havana.

The Electric Railways of Havana. Illustrated detailed description of the line now in course of construction and the equipment. 2000 w. St Ry Jour—Aug. 4, 1900. No. 35776 D.

Improvements.

Recent Improvements in the Southwest Missouri Electric Railway System. Illustrated detailed description of the equipment and operation of an interurban railway. 2800 w. St Ry Jour—Aug. 4, 1900. No. 35769 D.

Indiana.

The System of the Indiana Railway Co. An illustrated detailed description of the lines, with review of the history. 8000 w. St Ry Rev—Aug. 15, 1900. No. 35992 C.

Liverpool.

Liverpool Corporation Tramways. Illustrated description of the construction and equipment. 1300 w. Tram & Ry Wld—Aug. 9, 1900. No. 36176 A.

London.

New Electric Tramway Schemes for London. Extracts from the report of the Highways Committee concerning the proposed new tramways north and south of the Thames. 2000 w. Elec Rev, Lond—Aug. 3, 1900. No. 35790 A.

Manhattan Elevated.

The Electrical Equipment of the Manhattan Elevated Railway. Progress and details of this important installation. 1200 w. Elec Rev, N. Y.—Aug. 1, 1900. No. 35694.

Motor Cars.

The Development of Motor Cars for Electric Tramways (Die Entwickelung des Motorwagens für Elektrische Strassenbahnen). Max Stobrawa. A paper before the Elektrotechnische Gesellschaft at Cologne, giving a historical review of motor cars, with examples of present types. Serial. 1st part. 2200 w. Elektrotech Rundschau—Aug. 1, 1900. No. 35821 B.

Paris Exposition.

Electric Transportation at the Paris Exposition (Der Elektrische Verkehr auf der Ausstellung in Paris 1900). An illustrated account of the traveling sidewalk and the electric railway inside the Exposition grounds. 2000 w. Oest Monatschr f d Oeff Baudienst—Aug., 1900. No. 36152 G.

Paris Exposition Notes. Illustrated description of some of the railway and

tramway exhibits. 1500 w. St Ry Jour—Aug. 4, 1900. No. 35774 D.

Transportation at the Paris Exposition (Die Weltausstellung in Paris 1900. Das Verkehrswesen). Dr. J. Kollmann. A criticism of the transportation exhibit, and general description of local transportation about the Exposition, particularly of the moving sidewalk. Serial. 1st part. 4000 w. Zeitschr d Ver Deutscher Ing—July 21, 1900. No. 35869 D.

Paris Metropolitan.

The Metropolitan Railway of Paris (Chemins de Fer. Le Metropolitain de Paris. Description Générale du Réseau Projeté. Description Detaillée de la Partie Exécutée). A. Dumas. An elaborately illustrated description of this fine underground road, part of which is now in operation, and its construction. 16000 w. 5 plates. Génie Civil—July 21, 1900. No. 35881 D.

The Metropolitan Railway of Paris. An outline of the main features of this subway system, now 6¾ miles long, but planned to be 48½ miles. 1000 w. Eng Rec—Aug. 11, 1900. No. 35752.

The Paris Metropolitan Underground. A very complete illustrated account of the road and equipment. 1500 w. Elec Wld & Engr—Aug. 11, 1900. No. 35933.

Potential.

Fall of Potential Along Tramway Rails. E. Parry. A study of this problem of current distribution. 2000 w. Elect'n, Lond—Aug. 10, 1900. No. 35999 A.

Power Station.

The Ninety-Sixth Street Power Station of the Metropolitan Street Railway Company, of New York City. L. G. Montony. Illustrated detailed description. 7000 w. Pro Am Soc of Civ Engs—Aug., 1900. No. 36093 E.

Prague.

The Electric Generating System of Prague. Fred. Bathurst. Illustrated detailed description. 2000 w. Elec Rev, Lond—Aug. 17, 1900. Serial. 1st part. No. 36124 A.

Protection.

Protection of Telegraph and Telephone Wires in Connection with Overhead Traction. R. C. Quin. Read before the Munic. Elec. Assn. at Leeds, Eng. Brief paper discussing the usual practice. 1500 w. Elect'n, Lond—Aug. 10, 1900. No. 36001 A.

Repairing.

Testing and Repairing Methods of the North Jersey Street Railway Company. Illustrated description of the methods used at the Plank Road repair shop in Newark, N. J. 1400 w. St Ry Jour—Aug. 4, 1900. No. 35771 D.

Resistance.

Concerning Tractive Resistances. An article discussing the uncertain factors in train resistances at the high speeds to which electric traction tends. 1800 w. St Ry Jour—Aug. 4, 1900. No. 35773 D.

Safety Rules.

Safety Regulations for Electric Railway Plants (Sicherheitsregeln für Elektrische Bahnanlagen). The provisional regulations adopted by the Verband Deutscher Elektrotechniker for electric railways; and also those for theatres and for show windows and other places containing inflammable material. 4000 w. Elektrotech Zeitschr—Aug. 2, 1900. No. 35816 B.

Small Railways.

Can Small Electric Railways Be Operated at a Profit? James Blake Cahoon. Part first discusses conditions in small towns and means of increasing the patronage of the roads. 4800 w. St Ry Jour—Aug. 4, 1900. Serial. 1st part. No. 35772 D.

Subways.

Proposed Plans for Chicago Subways. Brief illustrated description of six subway loops to take cars of the street railway lines entering the business portion of the city. 1400 w. W Elect'n—Aug. 18, 1900. No. 35995.

Switzerland.

The Street Railway System of Geneva, Switzerland. An illustrated article giving points of interest in the construction and operation of an extensive system. 4000 w. St Ry Jour—Aug. 4, 1900. No. 35770 D.

Traction Meter.

See Electrical Engineering, Measurement.

Tramway Systems.

Conduit *v.* Trolley. J. Clifton Robinson. Opposing the construction of the costly conduit in London. 1400 w. Elec Engr, Lond—Aug. 10, 1900. No. 36017 A.

Transportation.

Trolley, Steam and Third Rail in Connecticut. Clarence Deming. Reviews the past ten years and the changes affected by improved facilities in transportation, touching upon the rivalries, and signs of progress. 2500 w. R R Gaz—Aug. 10, 1900. No. 35948.

Underground.

Electric Underground Railway in London. A description taken from the London *Times*. 1600 w. U. S. Cons Repts, No. 796—Aug. 2, 1900. No. 35654 D.

The Whitechapel and Bow Railway. Brief description of what will probably be the last steam underground railway of London. 1200 w. Engr, Lond—July 27, 1900. No. 35738 A.

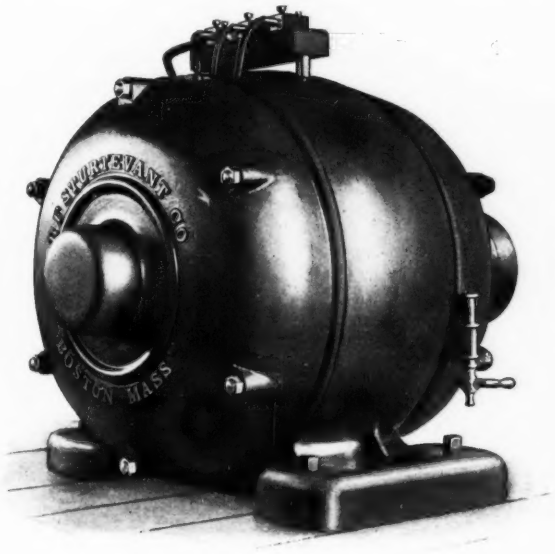
IMPROVED MACHINERY

New Processes and New Appliances

The matter here published is not paid for, nor can it be classed as advertising. But as the information is necessarily obtained from those who offer the appliances for sale, it is proper to say that the manufacturers, rather than ourselves, are responsible for the statements made.

An Inclosed Electric Motor.

THE bi-polar type of inclosed motor, the external construction of which is illustrated in the accompanying engraving, is manufactured both as a motor directly connected to a propeller fan and as an independent machine. For the former purpose it is used on all sizes of fans up to and including the 54-inch. For larger sizes the four and eight-pole types are employed.



The motor is entirely enclosed, and thereby protected from dust, a most important element in a machine used under these conditions. In order to avoid the excessive temperature which is incident to the operation of most enclosed motors, this type has been very carefully designed, so that a low temperature rise can be maintained without greatly increasing the size and weight above that of the ordinary open type.

This machine is capable of continuous operation for ten hours, with a maximum temperature rise not exceeding 60 degrees F. Yokes extending out from the field ring support the armature shaft. The end castings are entirely independent, and can be instantly removed to give access to the entire interior. The bearings and brushes can be reached by simply removing the caps in the center of the castings.

The brushes are of hard carbon, in holders of a modified reaction type, which allows of easy adjustment when it becomes necessary to reverse the direction of rotation of the motor. The bearings are self-oiling and self-aligning, and fitted with composition sleeves, which are removable

from the outer ends of the boxes. These motors, in sizes from 1-6 to 5 h.-p., are built by the B. F. Sturtevant Co., Boston, Mass.

The Aultman Balanced Shaking Screen.

THIS shaking screen, by reason of its construction, does not require any foundation, framework or bracing, other than is needed to support the weight of the screen and resist the pull of the driving belt. The usual destructive shake or vibration is, in the case of this screen, entirely prevented by a novel arrangement of the moving parts.

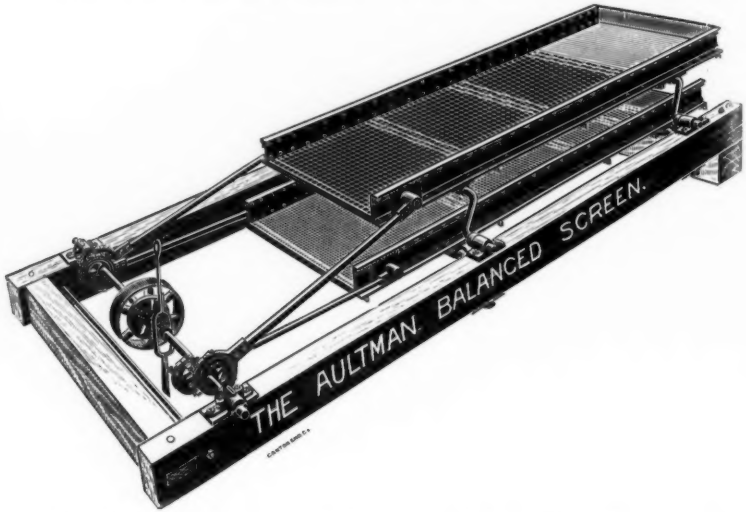
The forward and backward movement of the upper screen is perfectly counterbalanced by the reverse movement of the lower screen, and all of the thrust of the moving parts is completely absorbed in the heavy countershaft. No shake or vibration whatever is communicated to the structure upon which the screen is placed.

The screen frames are so placed on rocker arms that the screening surface always moves through a true arc. At each end of the stroke the material naturally raises slightly, and is again forcibly caught by another portion of the screening surface. Great capacity and the most thorough separation is secured on any material whatever that is subject to the screening process.

All bearings that require oiling are so far removed from the material that no oil or grease could possibly come in contact with the screened material.

Any material, wet or dry, that is subject to the process of screening, can be rapidly and perfectly separated. Favorable materials, such as sand, shale, fire clay, phosphate, cement, and coal, when dry, are thoroughly screened at the rate of fifteen to twenty tons per hour, and when damp at the rate of ten to fifteen tons per hour.

The dimensions are as follows: Length of upper and lower screens, 14 feet; width, 3 feet; height over all, 26 inches; size of friction pulley, 24 x 6 inches; speed of countershaft, 250 revolutions per minute. Space required for screen complete on skids, 18 feet x 4 feet 6 inches.



The frame carrying the wire cloth or perforated metal is in removable panels for convenience in renewing the wire cloth, and to provide for changes in the fineness of separation.

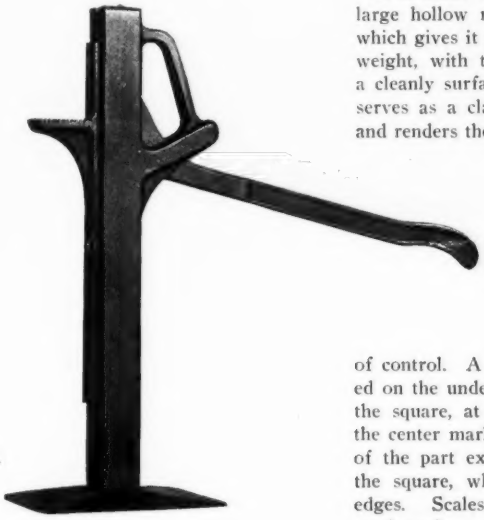
All who have seen the screens and observed their work have recognized that the Aultman Co. have removed many of the objectionable features in shaking screens, thereby greatly increasing their capacity. They are now prepared to build this screen for the general trade, with either two or four separations, and to guarantee its satis-

factory operation. Tests will be made on any material furnished and results submitted for consideration and comparison.

Inquiries are solicited from interested parties and will be given prompt attention. Descriptive catalogues are now ready for distribution. The Aultman Co., Canton, O.

Keystone Lifting Jack.

THE illustration herewith shows a novel form of lifting jack recently brought out, and designed for carriages, wagons, automobiles, and vehicles of every description. A new and ingenious rack adapts this jack to any height of axle, and when the lever is pushed, raising the axle, the jack locks automatically and no amount of weight can

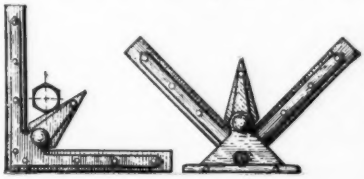


push it back. The jack consists of only three pieces, designed for strength and usage. There is not a bolt, pin, or screw in the whole device, so that its getting out of order is not conceivable. Another desirable feature is the large base, so that the jack is not tipped over by jars on the wagon.

Manufactured by P. C. Morrow, Newport, Pa., builders of many special appliances in brass and iron.

Universal Square.

THE increasing demand upon the draftsman to use various angles in the complex structures of the day, has called forth the device here illustrated, which may be called a Draftsman's Universal Square. It takes the place of the ordinary triangles for square work and hexagonal bolt heads,



and, with the base attachment, is quickly set to work at any angle against the T-square on all parts of the board.

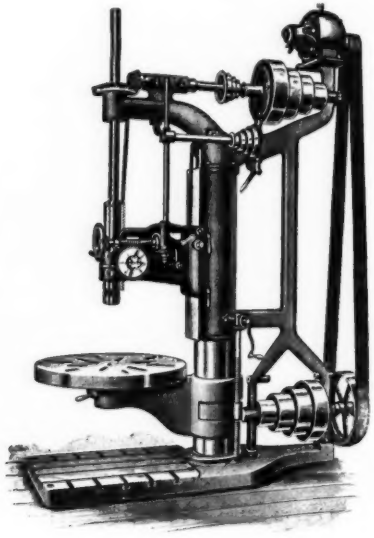
It is made of celluloid strips, secured by large hollow rivets to an aluminoid back, which gives it great strength and very light weight, with transparent ruling edges and a cleanly surface on the drawing. A knob serves as a clamp for the base attachment and renders the instrument exceedingly easy of control. A scale of degrees is graduated on the under side of one of the arms of the square, at the outer transparent edge, the center mark being near the pointed end of the part extending into the opening of the square, which also carries 60° ruling edges. Scales of inches and sixteenths, graduated on the under side of the inner ruling edges, are very useful in limiting lines, and avoiding the frequent use of a separate scale and erasures.

Manufactured by D. J. Kelsey, New Haven, Conn.

Novel Motor Mounting.

THE accompanying cut shows a unique way of mounting motors to a Barnes upright drill. In using what may be termed

a belt-connected motor, the customer is not only saved the expense of gearing, but this method places the motor away from the dirt and dust of the floor, and requires no extra floor space. Besides, the belt is noiseless and may be made as efficient as direct gearing. The manufacturers, W. F.



& John Barnes Co., Rockford, Ill., are prepared to furnish either the belt driven or geared motors, however. Illustrated catalogues are sent on request.

Industrial Notes.

Among the awards announced at the Paris Exposition is that on pneumatic tools, the same being bestowed on the Chicago Pneumatic Tool Co. in the form of a gold medal, the highest and, so far as appears from the printed reports, the only award made on this class of machinery. In addition to giving this company a gold medal, a gold medal was also given to Mr. Joseph Boyer, of St. Louis, the inventor of the Boyer pneumatic hammer, Boyer pneumatic drill, and other tools made by this company.

The Rand Drill Co., New York, manufacturers of rock-drilling and air-compressing machinery, was awarded three gold medals on this class of machinery at the Paris Exposition.

The New York Filter Manufacturing Co., New York, has closed a contract with Joseph Wescott & Son, to construct for the East Albany Water Co. a filtration plant at Rensselaer, N. Y., of 3,000,000 gallons daily capacity.

Among the orders recently booked by the Bethlehem Steel Co., South Bethlehem, Pa., are spare propeller shafts for the steamers *Ponce* and *San Juan,* of the New York & Porto Rico line, which are being furnished to Harlan & Hollingsworth. The Bethlehem Steel Co. is also furnishing eight forged hollow shafts of fluid-compressed open-hearth steel for use in Cuban sugar mills, and, in addition to these, a number of gun barrels for the Winchester Repeating Arms Co. The latter forgings are to be made of Bethlehem nickel-steel, which is particularly adapted to the purpose, on account of its ability to withstand severe strains.

A gold medal has been awarded to the Ball Engine Co., of Erie, Pa., who furnished the 350 horse-power engine for the electric motive power for the special machinery exhibit of the United States at the Paris Exposition.

The Grand Prize for mining machinery has been awarded to the Ingersoll-Sergeant Drill Co., New York, by the authorities of the Paris Exposition.

The branch office of the Bethlehem Steel Co., hitherto maintained at St. Louis, has been discontinued, and the territory covered by it will be handled from the Chicago office of the company.

In a recent communication to the Bullock Electric Mfg. Co., Geo. A. Fuller Co., contractors for the Broadway Chambers Building, New York City, a model of which is exhibited at the Paris Exposition, state, "Your dynamo forms a prominent feature of our exhibit, and helped to obtain the grand prize and gold medals which have been awarded to this exhibit."

A course of instruction by mail in chemistry is announced by the International Correspondence Schools, Scranton, Pa. The course includes mathematics, physics, theoretical, inorganic and organic chemistry, qualitative and quantitive analysis. George

Herman Dimpfel, Ph. D., who is in charge of the chemistry course, is a graduate of the University of Leipsic, and also studied in the Universities of Strassburg and Heidelberg. Later he was an instructor in the latter institution, but was induced to take up commercial work, and after an extended expenrience in European cities he came to this country, and is now principal of the School of Chemistry.

William Jessop & Sons, Ltd., have been awarded the Grand Prize at the Paris Exposition. The exhibit was much the same as that made at the Chicago Exposition of 1893. This is the twenty-eighth highest award taken by the Jessop steel.

Morse, Williams & Co., Philadelphia, Pa., report two particularly large contracts: One from the Union Passenger Station at Pittsburg, consisting of five hydraulic passenger elevators, two hydraulic passenger and freight elevators, six hydraulic freight elevators of the plunger type, all made with the latest improvements and designs. Another large contract is from the terminal station, Chesapeake & Ohio Railroad, for two hydraulic passenger and two hydraulic freight elevators.

The Jeffrey Manufacturing Co., Columbus, O., was awarded a gold medal at the Paris Exposition, covering its line of elevating, conveying and mining machinery.

Westinghouse, Church, Kerr & Co., New York, have taken the contract to construct an electric railroad from Grand Rapids to Muskegon, Mich., a distance of forty-four miles.

Charles A. Schieren & Co., New York, have taken the gold medal at the Paris Exposition, in competition with the leather belting manufacturers of England, Russia, Germany, the Netherlands and Scandinavia. Messrs. Schieren occupy 300 square feet, and their exhibit is highly interesting, from the 72-inch wide, three-ply belt down to the smallest single belt.

NEW CATALOGUES AND TRADE PUBLICATIONS

These catalogues may be had free of charge on application to the firms issuing them. Please mention The Engineering Magazine when you write.

Niles Tool Works Co., Hamilton, Ohio.—"Paris Exposition Catalogue," in French, English, and German. This is the most elaborate and handsomest machine tool catalogue we have seen, and was prepared especially for use at Paris. The letter-press is most tastefully displayed and the cuts of the tools exceptionally well printed. The embellishments in colors add much to the artistic effect of the page. The catalogue, which is nearly two hundred pages broad quarto, is attractively bound in full flexible morocco, blind stamped front and back, and lined with blue calf. The whole effect of the book is that of a rare *edition de luxe*.

Jeffrey Mfg. Co., Columbus, Ohio.—A catalogue in three languages for distribution at the Paris Exposition. A very full line of Jeffrey goods is shown and the text is amply explanatory of the excellent cuts.

Brown Hoisting and Conveying Machine Co., Cleveland, Ohio.—A quarto, buckram bound catalogue of automatic hoisting and conveying machinery manufactured by this company. The present catalogue is a most excellent example of modern business literature, being equally attractive in text, illustration, paper, and binding. Tint grounds to the cuts, and illuminated initials contribute in a large measure to the generally pleasing effect. The cover is lined with a specially designed lithographed "Brownhoist" paper.

Phosphor-Bronze Smelting Co. Philadelphia, Pa.—Price List No. 17 of Phosphor-Bronze goods, including roll and sheet metal, spring and telephone wire and wire rope, ingots and castings, and "Elephant" brand alloys and anti-friction metals.

Schäffer & Budenberg, Brooklyn, N. Y.—Folder illlustrating radiator air valves of many designs manufactured by this house. Separate folders are to be had on indicating and recording pressure gauges, injectors and ejectors, steam traps and separators, water gauges and compression gauge cocks, low pressure safety valves, and many styles of steam whistles.

Sprague Electric Company, New York.—(*a*) Bulletin No. 200, showing "Lundell" motor equipments for printing establishments and book binderies. The display is varied and highly interesting; (*b*) Bulletin No. 401, illustrating and describing Greenfield flexible steel armored con-

ductors for lamp pendants and portables in machine shops, mills, factories, engine and boiler rooms, foundries, etc., where flexible cords are almost indispensable, and where ordinary cord will not withstand the exacting conditions of service.

Jos. Dixon Crucible Co., Jersey City, N. J.—"Words of Wisdom About Paint," being a small folder setting forth the economy of Dixon's silica-graphite paint for tin, steel or shingle roofs, or exposed surfaces.

James McCrea & Co., 13 and 15 So. Canal street, Chicago, Ill.—A new catalogue of the "Climax" steam joint clamp, a device by which ruptures in steam pipes may be repaired without shutting down.

Bignall & Keeler Mfg. Co., Edwardsville, Ill.—A tastefully designed booklet descriptive of their line of "Peerless" combination bench and pipe vises, of which two patterns are made.

Nordberg Manufacturing Co., Milwaukee, Wis.—A handsome catalogue, fully illustrating and describing the series of air compressors designed by B. V. Nordberg. Several noteworthy indicator cards are shown, and a list of prominent Nordberg compressors plants is given.

Buckeye Portland Cement Co., Bellefontaine.—"How to Use Portland Cement," being a handy little treatise on cement and its proper use. The numerous illustrations add to the interest, and the tables make it very valuable to the engineer and architect.

Westinghouse, Church, Kerr & Co., New York.—Folder giving a list of sme prominent installations of the Roney mechanical stoker.

Seneca Falls Mfg. Co., Seneca Falls, N. Y.—Envelope slip in two colors, briefly illustrating and describing the "Star" foot and power lathes, and announcing a new catalogue.

Dean Bros. Steam Pump Works, Indianapolis, Ind.—Catalogue No. 42 of single style steam pumps. A very dainty brochure, giving in neatly printed pages a vast amount of useful data to the steam pump user or intending buyer.

A. Leschen & Sons Rope Co., St. Louis, Mo.—A well written descriptive catalogue of the Finlayson automatic aerial wire rope tramway. The illustrations are striking, and, in connection with the text form a very comprehensive description of the Finlayson system.

Consolidated Telpherage Co., New York.—Circular No. 7, describing a novel overhead cableway.

Triumph Electric Co., Cincinnati, Ohio.—Bulletin No. 141, illustrating and describing very fully the "Triumph" engine type of direct-connected generator. This is an excellent specimen of the trade "bulletin," and conveys just the information the buyer needs.

Westinghouse Electric and Mfg. Co., Pittsburg, Pa.—A handsome album, showing many installations of electric motors for the operation of machinery. The captions to the views are in four languages, and the whole design of the album is highly pleasing.

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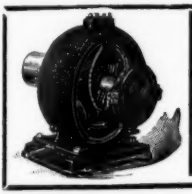

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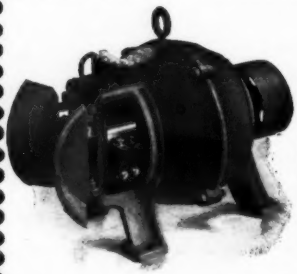

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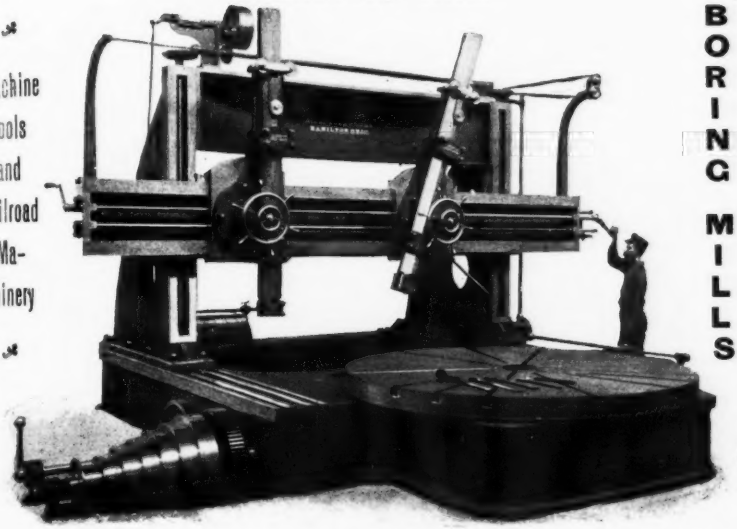

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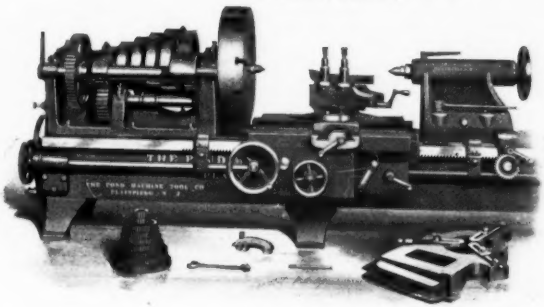

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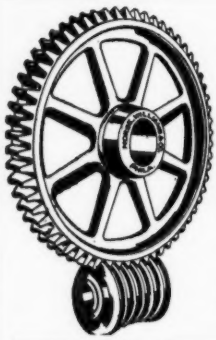

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